

## Table of Contents

### Thursday, July 10<sup>th</sup> 2003

<b>8:15 – 9:30</b>					
The Significance of Exercise and Sport in a Life Span Plenary Session	Hall H PL10H	9	Traumatology Oral Session	Hall E O102E	39
			New Trends in Sport-Physiotherapy Symposium	Hall F S102F	42
<b>9:40 – 11:10</b>					
New Insights in the Regulation of Fat Metabolism Symposium	Hall A S101A	10	Neuromuscular-skeletal Adaptation and Aging Symposium	Hall G S102G	43
JSPFSM Exchange Symposium	Hall B S101B	12	Health Enhancing Physical Activity - Promoting Environments Symposium	Hall H S102H	45
Health and Fitness 1: Elderly Oral Session	Hall C O101C	14	Biomechanics 2: Running Biomechanics Oral Session	Hall I O102I	47
Social Integration and Sport Symposium	Hall D S101D	16	Sports Medicine Oral Session	Hall J O102J	50
Rehabilitation Oral Session	Hall E O101E	18			
Muskuloskeletal Loading during Human Locomotion: Direct and Indirect Approaches Symposium	Hall F S101F	20	<b>14:15 – 15:15</b>		
Peripheral and Centrally Organized Activation in Motor Learning Symposium	Hall G S101G	22	Training and Testing 1 Poster Session	Poster M P10M	54
Physical Fitness and Health: Epidemiology Symposium	Hall H S101H	23	Training and Testing 2 Poster Session	Poster N P10N	59
Biomechanics 1 Oral Session	Hall I O101I	25	Training and Testing 3 Poster Session	Poster O P10O	65
Physiology 1 Oral Session	Hall J O101J	28	Physiology 1 Poster Session	Poster P P10P	70
			Physiology 2 Poster Session	Poster Q P10Q	76
			Physiology 3 Poster Session	Poster R P10R	83
<b>11:40 – 13:10</b>			Health and Fitness 1 - Sports Medicine 1 Poster Session	Poster S P10S	89
The Molecular Adaptation to Aerobic Exercise Symposium	Hall A S102A	31	Sports Medicine 2 Poster Session	Poster T P10T	95
Physiology 2 Oral Session	Hall B O102B	32	Health and Fitness 2 Poster Session	Poster U P10U	101
Health and Fitness 2 Oral Session	Hall C O102C	35	Psychology 1 - Motor Learning 1 - Computer Science 1 Poster Session	Poster V P10V	107
Education through Sport Symposium	Hall D S102D	38	Psychology 2 Poster Session	Poster W P10W	112

## Table of Contents

Psychology 3 - Computer Science 2 Poster Session	Poster X P10X	119	Health and Fitness 3 Oral Session	Hall J O103J	155
Biomechanics 1 Poster Session	Poster Y P10Y	124	<b>17:00 – 18:30</b>		
Biomechanics 2 Poster Session	Poster Z P10Z	131	Gender Aspects of Exercise and Training Symposium	Hall A S104A	158
<b>15:15 – 16:45</b>			Biomechanics 4 Oral Session	Hall B O104B	160
Gene Expression: Training and Diet Interaction Symposium	Hall A S103A	138	Physical Education and Pedagogics 1 Oral Session	Hall C O104C	162
Physiology 3: Hypoxia Oral Session	Hall B O103B	139	E-Learning and Information Asset Management: Converging Technologies for Research and Education Symposium	Hall D S104D	165
Physical Education/Philosophy Oral Session	Hall C O103C	141	Communication Oral Session	Hall E O104E	166
Psycho-Social Aspects of Rehabilitation Symposium	Hall D S103D	144	Resistance Training for the Elderly (ACSM Exchange Symposium) Symposium	Hall F S104F	169
Sociology 1 Oral Session	Hall E O103E	145	Coordination Dynamics and its Relevance to Sport and Exercise Symposium	Hall G S104G	170
Injury Prevention and Orthotics Symposium	Hall F S103F	148	Measurement of Physical Activity Symposium	Hall H S104H	172
Exercise, Movement and Brain Symposium	Hall G S103G	149	Biomechanics 5: Reflex and Stimulation Oral Session	Hall I O104I	174
From Inactivity to Activity - Intervention Concepts and Longitudinal Effects Symposium	Hall H S103H	151	Training and Testing 1 Oral Session	Hall J O104J	177
Biomechanics 3: Muscles and Tendons Oral Session	Hall I O103I	153			

### Friday, July 11<sup>th</sup> 2003

<b>8:15 – 9:30</b>			Molecular Biology 1 Oral Session	Hall C O111C	185
Challenges of Elite Sport Plenary Session	Hall H PL11H	180	History of Sport Science Symposium	Hall D S111D	188
<b>9:40 – 11:10</b>			Computer Science in Sport Oral Session	Hall E O111E	189
Neuronal Mechanisms in Strength and Power Training Symposium	Hall A S111A	181	Psycho-Social Aspects of Elite Sport Symposium	Hall F S111F	191
Nutrition Oral Session	Hall B O111B	183			

## Table of Contents

Biomechanics in Elite Sport Performance Symposium	Hall G S111G	193	Physiology 4 Poster Session	Poster P P11P	243
Elite Sport and Immune System Symposium	Hall H S111H	195	Physiology 5 Poster Session	Poster Q P11Q	248
Motor Learning Oral Session	Hall I O111I	196	Physiology 6 Poster Session	Poster R P11R	255
Physiology 4: Endocrinology Oral Session	Hall J O111J	199	Sports Medicine 3 - Health and Fitness 3 Poster Session	Poster S P11S	261
<b>11:40 – 13:10</b>			Sports Medicine 4 - Health and Fitness 4 Poster Session	Poster T P11T	266
Testing and Training Symposium	Hall A S112A	202	Health and Fitness 5 Poster Session	Poster U P11U	271
Physiology 5: Muscles and Tendons Oral Session	Hall B O112B	204	Motor Learning 2 – Sociology 1 Poster Session	Poster V P11V	277
Molecular Biology 2 Oral Session	Hall C O112C	207	Physical Education and Pedagogics 1 – Sociology 2 – Philosophy 1 Poster Session	Poster W P11W	283
Physiology and Biomechanics of Alpine Skiing Symposium	Hall D S112D	210	Training and Testing 7 – Communication 1 - Philosophy 2 – History 1 Poster Session	Poster X P11X	289
Sociology 2: Integration Oral Session	Hall E O112E	212	Biomechanics 3 Poster Session	Poster Y P11Y	295
Sport Psychology: Research and Application to Elite Sport - an Area of Conflict? Symposium	Hall F S112F	215	Biomechanics 4 Poster Session	Poster Z P11Z	302
Vibrations in Sport and Exercise Symposium	Hall G S112G	216	<b>15:15 – 16:45</b>		
Overtraining Symposium	Hall H S112H	218	Analysis of Sport Related Factors of Performance (interdisciplinary strategies) Symposium	Hall A S113A	309
Physical Education and Pedagogics 2 Oral Session	Hall I O112I	220	Psychology 1 Oral Session	Hall B O113B	310
Biomechanics 6 Oral Session	Hall J O112J	222	Physiology 6 Oral Session	Hall C O113C	313
<b>14:15 – 15:15</b>			Elite Gymnastics Symposium	Hall D S113D	315
Training and Testing 4 Poster Session	Poster M P11M	226	Training and Testing 2: Energy Metabolism and Workload Oral Session	Hall E O113E	318
Training and Testing 5 Poster Session	Poster N P11N	231	Antioxidants and Gene Regulation in Physical Activity and Aging Symposium	Hall F S113F	320
Training and Testing 6 Poster Session	Poster O P11O	237			

## Table of Contents

Technology and Performance in Elite Sport Symposium	Hall G S113G	321	Cross Country Skiing Symposium	Hall D S114D	336
New Developments in Sports Nutrition 1 Symposium	Hall H S113H	324	Training and Testing 3: Diagnostics Oral Session	Hall E O114E	338
Physical Activity and Neural Cardiovascular Regulation in Health and Disease(EFSMA Exchange Symposium)	Hall I S113I	326	Control of Gas Exchange during Exercise Symposium	Hall F S114F	340
Biomechanics 7: Muscle and Leg Stiffness Oral Session	Hall J O113J	327	Computer Science in Elite Sport Symposium	Hall G S114G	342
<b>17:00 – 18:30</b>			New Developments in Sports Nutrition 2 Symposium	Hall H S114H	344
Sport Talent: Quo Vadis? Symposium	Hall A S114A	330	Biomechanics 8 Oral Session	Hall I O114I	344
Psychology 2 Oral Session	Hall B O114B	331	Biomechanics 9: Muscle Strength Oral Session	Hall J O114J	346
Ball Games: Analysis and Performance Oral Session	Hall C O114C	334			

### Saturday, July 12<sup>th</sup> 2003

<b>8:15 – 9:30</b>			Elite Soccer Symposium	Hall G S121G	362
Physical Activity and Exercise and their Effect on Chronic Disease and Impairments Plenary Session	Hall H PL12H	350	Exercise and Cancer Symposium	Hall H S121H	364
<b>9:40 – 11:10</b>			Biomechanics 10 Oral Session	Hall I O121I	365
Exercise and Cardiorespiratory Disease Symposium	Hall A S121A	351	Physiology 9: Elderly Oral Session	Hall J O121J	367
Physiology 7 Oral Session	Hall B O121B	352	Training and Testing 4 Oral Session	Hall K O121K	370
Health and Fitness 4: Health Related Physical Fitness Oral Session	Hall C O121C	355	<b>11:40 – 13:10</b>		
Physical Activity after Endoprothetic Surgery Symposium	Hall D S121D	357	Exercise Performance at Moderate Altitudes in Health and Disease Symposium	Hall A S122A	373
Physiology 8: Muscle Physiology Oral Session	Hall E O121E	359	Physiology 10 Oral Session	Hall B O122B	374
High Performance Cycling Symposium	Hall F S121F	361	Training and Testing 5: Vibration Oral Session	Hall C O122C	377

## Table of Contents

The Paralympic Athletes Symposium	Hall D S122D	380	Nutrition 1 – Biochemistry 1 - Molecular Biology 1 Poster Session	Poster V P12V	450
Physiology 11: Oxygen Kinetics Oral Session	Hall E O122E	381	Nutrition 2 Poster Session	Poster W P12W	456
Measurement and Therapy in Prevention and Rehabilitation Symposium	Hall F S122F	384	<b>16:25 – 17:25</b>		
The epistemological ecologies of sport and exercise sciences (ICSSPE Exchange Symposium)	Hall G S122G	385	Physical Activity and Health - What is the evidence? ECSS Plenary Debate	Hall H PD12H	463
Exercise and Metabolic Syndrome Symposium	Hall H S122H	386	<b>Abstracts without Presentation</b>		
Biomechanics 11 Oral Session	Hall I O122I	387	<b>List of Authors</b>		
Biomechanics 12: Eccentric Muscle Activity Oral Session	Hall J O122J	390	<b>Keywords</b>		
Physical Education/Physiology Oral Session	Hall K O122K	393	492		
<b>14:15 – 15:15</b>					
Rehabilitation 1 – Physiotherapy 1 Poster Session	Poster M P12M	396			
Physiology 7 - Traumatology 1 – Rehabilitation 2 Poster Session	Poster N P12N	401			
Physiology 8 – Rehabilitation 3 Poster Session	Poster O P12O	407			
Physical Education and Pedagogics 2 Poster Session	Poster P P12P	413			
Physical Education and Pedagogics 3 Poster Session	Poster Q P12Q	418			
Physical Education and Pedagogics 4 Poster Session	Poster R P12R	425			
Sports Medicine 5 Poster Session	Poster S P12S	433			
Health and Fitness 6 Poster Session	Poster T P12T	439			
Health and Fitness 7 Poster Session	Poster U P12U	445			

## Plenary Session

### The Significance of Exercise and Sport in a Life Span

PL10H

#### PL10H-1

##### From behaviour to health

**Owen Neville**

The University of Queensland, Australia

*Keywords: population health, behavioral epidemiology, chronic disease*

Public health strategies for chronic disease prevention target the total population. Such approaches broadly include mass media campaigns to educate, inform and motivate large numbers of people and policy and environmental initiatives to make healthier choices easier choices. In the case of physical activity, some 60% of adults in industrialised countries may be classified as insufficiently active for health benefits. Rates of overweight and obesity are reaching epidemic proportions in many countries and rates of type 2 diabetes are increasing rapidly. These changes are associated with greatly increased risk of future heart disease, breast and colon cancer. In this context, cigarette smoking, food choices and physical inactivity are the behaviours of particular concern to policy makers and practitioners. The effects of these and other behavioural choices in the everyday context of people's lives accumulate, increasing risk of chronic disease outcomes and exacerbating risk in those with chronic diseases. Findings from research on physical activity can help to increase our understanding of ways to influence these behaviours that impact significantly on health. Building on earlier frameworks from cancer prevention, the behavioural epidemiology framework identifies five phases of research that can usefully systematise approaches to understanding health behaviours for preventive purposes: establish links between behaviours and health; develop measures of the behaviour; identify influences on the behaviour; evaluate interventions to change the behaviour; and, translate research into practice. Research strategies to identify modifiable behavioural determinants and analyses of the effects of population-wide interventions are examined within this framework, along with the conceptual and methodological challenges that are arising as these new areas of research are being developed. New domains of research opportunity in population based approaches to physical activity behaviour and health are considered. Many of these involve integrating approaches from exercise science, psychology and epidemiology as well as new opportunities with broader disciplines such as social geography and urban planning. Such research and the new ideas and approaches emerging from it, should be helpful in guiding future prevention strategies for chronic disease in ageing populations.

#### PL10H-2

##### From biology to health

**Booth Frank**

University of Missouri, United States

*Keywords: gene expression, physical inactivity, chronic disease*

The recent sequencing of the human genome has opened an unprecedented opportunity to exercise scientists to identify genes that require daily physical activity for proper expression of proteins to maintain health. Observational studies have shown that the prevalence of chronic disorders (e.g., obesity, type 2 diabetes, coronary artery disease) has increased in a remarkably short period when measured by evolutionary scale. Epidemiological research proves that physical inactivity contributes to the increased incidence of chronic disorders. A hypothesis has been generated that genes evolved to support a physically active lifestyle and that physical activity genes misexpress in periods of physical inactivity. Speculation will be made that the human genome requires physical activity to keep metabolic pathways in proper function or shape, much as the analogy that a race car needs running to maintain its fine tuning. Physical activity can be considered as an environmental modulator of gene expression so that health is maintained above the threshold of overt clinical disease. We propose that exercise biologists in the past have not studied 'the effect of physical activity', but in reality they have studied the effect of reintroducing exercise into an unhealthy sedentary population that is genetically programmed to expect physical activity. Biological explanations that connect physical inactivity to disease will be discussed. We will propose that evolution selected for the exercise-responsive cycling of GLUT4 and LPL proteins based upon Neel's Thrifty Gene Hypothesis (the Feast and Famine/Activity Cycle). We will further propose that sedentary lifestyles in a culture with unlimited access to food cause a stalling of the Feast and Famine/Activity Cycle. As it is unlikely that the stall in the cycle will be broken by famine, the only alternative mode to end cycle stalling is to deplete energy stores of glycogen and triglycerides in skeletal muscle that undertakes physical activity, which mimics the phase of the cycle during evolution when humans had to exercise during famine to acquire food. In summary then, we will propose that genes expecting physical activity for proper expression to maintain health can be better understood by application of the concepts of evolutionary medicine.

## Symposium

### New Insights in the Regulation of Fat Metabolism

**S101A****S101A-1****New insights in the regulation of fat metabolism during exercise: introduction of the symposium.****Wagenmakers Anton**

Maastricht University, The Netherlands

*Keywords: insulin resistance, lipid metabolism, cardiovascular disease*

The aim of this symposium is to give an update of the latest insights in the use of fatty acids (FA) and triglycerides (TG) as fuels during exercise and on the mechanistic links between high fat oxidation rates, cardiovascular health and insulin resistance. Tracer methodology measuring the oxidation of <sup>13</sup>C-labeled fatty acids in combination with indirect calorimetry can be used to quantitate the oxidation of the main fat sources. These are plasma FA that are released by adipose tissue lipolysis and the sum of skeletal muscle TG and TG present in very low density lipoproteins (VLDL) circulating in the blood. In untrained and sedentary subjects, obese subjects and patients with type 2 diabetes plasma FA are the only oxidized fat source; while in trained endurance athletes skeletal muscle and VLDL TG's together contribute about 50%. Mild training increases total fat oxidation primarily via an increase of the capacity to oxidize the TG sources. The consumption of TG during exercise is attended by a 40-50% reduction in the plasma TG levels throughout the day. This seems to indicate that VLDL-TG in the post-exercise period is used to fill up the muscle TG stores. The chronic lowering of the plasma TG levels seems to explain the lower cardiovascular disease risk in trained subjects. The size of the muscle TG stores is larger in obese subjects and patients with type 2 diabetes and shows a high positive correlation to the development of insulin resistance. The molecular mechanisms that have recently been proposed to explain this link will be summarised.

Insights in the health effects of exercise are hampered by discrepancies between laboratories on whether muscle TG are used during exercise. Dr Luc van Loon will, therefore, compare several methods and present his latest data on this topic. The enzyme that is responsible for the lipolysis of muscle TG is hormone sensitive lipase (HSL). The activity of this enzyme is controlled by phosphorylation/dephosphorylation mechanisms and by allosteric metabolites that bind to the enzyme, modify the 3-dimensional structure and thus activate or inactivate the enzyme. For a full comprehension of the regulation of muscle lipolysis during exercise we need much more information on the regulation of muscle HSL. Dr Morten Donsmark and Dr Lawrence Spriet will present the latest information on the regulation of HSL in rat and human muscle by exercise and other stimuli and its role in the regulation of lipid metabolism.

**S101A-2****The use of intramuscular triglycerides during exercise****Van Loon Luc**

Maastricht University, The Netherlands

*Keywords: exercise, IMTG, muscle metabolism*

The majority of our energy reserves is stored as fat, mainly deposited as triacylglycerol (TG) in subcutaneous and visceral adipose tissue. Smaller quantities of TG are incorporated in lipoprotein particles and as lipid droplets inside the muscle fibres, intramuscular triacylglycerol (IMTG). The latter has regained much attention due to the reported association between IMTG accumulation and insulin resistance. The proposed relationship is likely mediated by other related factors, as skeletal muscle of endurance athletes is markedly insulin sensitive despite an elevated IMTG content. The higher IMTG content in the endurance athlete suggests that IMTG stores represent an important substrate source during exercise. The latter has been disputed due to some discrepancy in the literature, which is likely explained by differences in the applied exercise protocol, the selected subject population as well as the applied technique(s) used to estimate IMTG utilisation.

Whereas (whole-body) stable isotope methodology only provides information on plasma FFA oxidation rates and the use of other fat sources (sum of muscle and lipoprotein derived TG), magnetic resonance spectroscopy and the muscle TG extraction method are subsequently limited to the quantification of net muscle TG content in mixed muscle samples. Subsequently, these techniques do not discriminate between muscle fibre type specific IMTG content. The latter could be of significance as muscle fibre type recruitment during endurance type exercise predominantly relies on type I muscle fibres, which have been shown to contain about 3-4 times more lipid than type II fibres. Clearly, if a net decline in IMTG content occurs in muscle following prolonged moderate intensity exercise, it should likely be most predominant in the type I muscle fibres. To enable direct and selective quantification of muscle TG content on a fibre type specific intramyocellular level, oil red O staining of muscle cross-sections has been combined with (immuno)fluorescence microscopy. The latter was recently applied to show that in trained male athletes prolonged moderate intensity exercise results in a substantial net decline in muscle TG content, which was specific for muscle fibre type.

IMTG represent an important substrate source during prolonged moderate intensity exercise in male athletes. As endurance training increases the capacity to mobilise and/or oxidise IMTG, more research is warranted to develop exercise, nutritional and/or pharmacological interventions to maximise IMTG use in obese and/or type 2 diabetes patients.

## S101A-3

**Regulation and expression of hormone-sensitive lipase (HSL) in rat skeletal muscle****Donsmark Morten, Langfort Jozef, Holm Cecilia, Ploug Thorkil, Galbo Henrik**

University of Copenhagen, Denmark

*Keywords: muscle, triacylglycerol, lipolysis*

Intramycellular triacylglycerol (TG) is an important energy store and the energy content of this depot is higher than the energy content of the muscle glycogen depot. Interestingly, the TG depot has recently been related to insulin resistance. We have provided evidence that the mobilization of fatty acids from this TG pool may be regulated by the enzyme hormone-sensitive lipase (HSL). This enzyme is known as the rate-limiting enzyme of intracellular TG hydrolysis in adipose tissue.

We demonstrated the presence of HSL in isolated rat skeletal muscle fibers by Western blotting and the expression of HSL was correlated to fiber type, being higher in oxidative than in glycolytic fibers. In incubated soleus and extensor digitorum longus (EDL) muscles stimulation with adrenaline or electrically induced contractions increased HSL activity measured by a triacylglycerol substrate.

No HSL activation existed when analyses was performed in the presence of an anti-HSL antibody. The effect of adrenaline could be blocked by propranolol and mimicked by incubation of a crude supernatant from control muscle with the catalytic subunit of cAMP-dependent protein kinase. The effect of contractions was transient as HSL activity declined to basal level after 10 min of electrical stimulation. Indicating involvement of phosphorylation okadaic acid doubled the contraction-mediated increase in HSL activity whereas the increase was reversed by phosphatase treatment. Furthermore, we demonstrated that two different PKC inhibitors abolished the contraction-induced activation of HSL. Because some of PKC's effects are mediated by the MAPK pathway we investigated the influence of a specific MAPK inhibitor, U0126. This inhibitor reduced the contraction-induced activation of HSL with 50%. Correspondingly, activated ERK increased HSL activity in crude supernatant from control muscle. The effects of adrenaline and contractions were partially additive. Training increased adrenaline stimulated HSL activity in rat adipose tissue but not in muscle. Interestingly, training increased contraction-mediated HSL activity in muscle.

In conclusion, HSL is present in skeletal muscle and can be activated by different kinases in response to adrenaline and muscle contractions, respectively. Training increases adrenaline-stimulated HSL activation in adipose tissue and contraction-mediated HSL activation in muscle.

## S101A-4

**Regulation and role of hormone sensitive lipase in human muscle****Spriet Lawrence L, Watt Matthew J, Heigenhauser George JF**

University of Guelph, Canada

*Keywords: fat metabolism, human skeletal muscle, hormone sensitive lipase*

Hormone sensitive lipase (HSL) is believed to play a regulatory role in initiating the degradation of intramuscular triacylglycerol (IMTG) in skeletal muscle. We recently conducted a series of studies in human skeletal muscle designed to characterize the response of HSL to two stimuli: exercise of varying intensities and durations and epinephrine infusions. In an attempt to understand the regulation of HSL activity we also measured the changes in the putative intramuscular and hormonal regulators of the enzyme. In human skeletal muscle at rest, there is a high constitutive level of HSL in the active form (HSLa), which does not appear to be a function of biopsy sampling or freezing. The combination of low adrenaline and calcium levels and resting levels of insulin appear to dictate the levels of HSLa measured at rest. During the onset of low and moderate aerobic exercise (initial minute), HSL is activated by contractions in the apparent absence of increases in circulating adrenaline (Watt et al 2003a).

Adrenaline may contribute to the early activation of HSL during intense aerobic exercise. The contraction-induced activation may be related to increased calcium and/or other unknown activators. As low and moderate intensity exercise continues beyond a few minutes, activation by adrenaline through the cAMP cascade also appears to occur. With prolonged moderate intensity exercise beyond 1-2 hours, HSLa decreases in spite of continuing increases in adrenaline by some unknown mechanism. Actual flux (IMTG lipolysis) through HSLa may be allosterically inhibited during prolonged exercise due to the accumulation of LCFA-CoA. Finally, during sustained higher intensity exercise, activation of AMP kinase and phosphorylation of inhibitory sites on HSL may decrease HSLa in this situation where the need for fat oxidation is decreased. The existing work in human skeletal muscle also supports the idea that there are numerous levels of control involved in the regulation of IMTG lipolysis, with control points downstream from HSL also playing important roles.



## Symposium

## JSPFSM Exchange Symposium

S101B

## S101B-1

**Effects of physical training on cortical bone at mid-tibia assessed by peripheral QCT**

Liu LiJing, Maruno Ryouko, Mashimo Tomoko, Sanka Kazunori, Higuchi Tai, Hayashi Kazuhiko, Shirasaki Yoshio, Mukai Naoki, Saitoh Shinichi, Tokuyama Kumpei  
Institute of Health and Sport Sciences, Japan

**Keywords:** *swimming, BMD*

Effects of long-term exercise on volumetric bone mineral density (vBMD), bone mineral content, bone geometric properties and the strength index of bone were examined in a cross-sectional study of athletes and controls.

Tibias of 25 jumpers (13 females), 30 swimmers (15 females) and 25 controls (15 females), aged 18-23, were scanned at mid site using peripheral quantitative computed tomography (pQCT). The pQCT image was transmitted to a Macintosh computer in Custom mode (resolution: 256 x 256 pixels), and imported to NIH Image software to analyze vBMD, geometric properties and strength index of tibias.

There was no significant difference in height among the male groups, while swimmers were significantly heavier than the other groups. The female athletes were significantly taller and heavier than the controls, although there were no significant differences between swimmers and jumpers. The starting age of training was earlier for the swimmers than the jumpers in both males and females ( $9.8 \pm 1.9$ ,  $12.8 \pm 2.1$ yr, respectively for male swimmers and jumpers, and  $7.6 \pm 1.9$ ,  $12.7 \pm 1.5$  yr, respectively for female swimmers and jumpers). The cortical vBMD of female athletes was lower than that of the controls ( $2.00 \pm 0.05$ ,  $1.90 \pm 0.08$  and  $1.92 \pm 0.12$  g/cm<sup>3</sup>, respectively for controls, swimmers and jumpers). On the other hand, periosteal areas of male jumpers and female athletes were greater than that of controls ( $460 \pm 50$ ,  $483 \pm 46$  and  $512 \pm 55$ mm<sup>2</sup>, respectively for male controls, swimmers and jumpers, and  $283 \pm 52$ ,  $341 \pm 73$  and  $378 \pm 75$  mm<sup>2</sup>, respectively for female controls, swimmers and jumpers). The endocortical area of female swimmers was greater than that of controls ( $103 \pm 29$ ,  $148 \pm 52$  and  $135 \pm 54$  mm<sup>2</sup>, respectively for controls, swimmers and jumpers). The polar moment of inertia of male jumpers and female athletes were significantly greater than that of controls.

We conclude that the improvement of mechanical properties of young adult bone in response to long-term exercise is related to geometric adaptation and not to vBMD. And also in female swimmers, physical training started in the earlier part of puberty may contribute to enlarge endocortical area, which caused the cortical drift toward periosteal direction resulted in a significant improvement of the mechanical characteristics at mid-tibia.

## S101B-2

**Effects of exhaustive exercise on circulating levels of interleukin-12 p40/p70**

Suzuki Katsuhiko, Nakaji Shigeyuki, Kurakake Shigeyoshi, Totsuka Manabu, Sato Koki, Xuan Zhao, Fujimoto Hanae, Shibusawa Kentaro, Machida Kazuhiko, Sugawara Kazuo

Hirosaki University School of Medicine, Japan

**Keywords:** *interleukin-12, cytokines, immunity*

It is known that interleukin (IL)-12 p70 promotes the differentiation of helper T type-1 (Th1) cells, which produce type-1 cytokines (IL-2 and interferons), thereby supporting cellular immunity, whereas IL-12 p40 acts as an IL-12 antagonist. In contrast, Th2 cells produce type-2 cytokines (IL-4, IL-6 and IL-10) and induce humoral immunity and allergic reactions. Although exhaustive exercise causes the suppression of cellular immunity whereas asthmatic and allergic diseases are subclinically prevalent in athletes, one of the mechanisms behind these observations may be the type-1<type-2 cytokine balance, which we demonstrated after exercise (Suzuki et al. 2000, Suzuki et al. 2002). The present study examined circulating levels of IL-12 subtype p40 and p70 following exercise for the first time.

Details on the subjects and exercise conditions were reported in our previous studies. Briefly, 10 male athletes underwent maximal exercise on a treadmill and peripheral venous blood samples were obtained before, immediately after, 1 h and 2 h after exercise (Suzuki et al. 2002). Also, blood samples were obtained from 10 male runners before and after a 42.195-km marathon race, whose finishing time ranged 2 h 33 min to 2 h 41 min (Suzuki et al. 2003). Plasma concentrations of IL-12 p40 and p70 were measured separately with enzyme-linked immunosorbent assay kits, and the sensitivity limits were 3.9 pg/ml and 0.5 pg/ml, respectively.

Plasma concentration of IL-12 p40 rose significantly 1 h after maximal exercise. The marathon race induced a more marked increase in IL-12 p40. In contrast, plasma IL-12 p70 could not be detected, which is consistent with previous work using a kit from another company (Suzuki et al. 2000, Suzuki et al. 2002).

There is only one study showing the increase in plasma IL-12 immediately after maximal exercise (Akimoto et al. 2000); other studies have failed to show any release of IL-12 with exercise (Suzuki et al. 2000, Suzuki et al. 2002). In this study, we first measured IL-12 p40 and p70 separately, and demonstrated that IL-12 p40 was present in great excess of p70 especially after exercise. Therefore, it is possible that exhaustive exercise might cause a decrease in the production of type-1 cytokines, which may explain the observations of cellular immunosuppression following exhaustive exercise.

Suzuki K, et al. (2000). *Eur. J. Appl. Physiol.* 81:281-7

Suzuki K, et al. (2002). *Exerc. Immunol. Rev.* 8: 6-48

Suzuki K, et al. (2003). *Med. Sci. Sports Exerc.* 35: 348-55

Akimoto T, et al. (2000). *Eur. J. Appl. Physiol.* 81:510-2

## S101B-3

**FFA and Glucose uptake of skeletal muscle and myocardium at different exercise intensity**

Fujimoto Toshihiko, Kemppainen Jukka, Itoh Masatoshi, Kitada Koji, Kubota Kazuo, Ishii Kenji, Yamaguchi Keiichiro, Nagatomi Ryoichi, Knuuti Juhani

Tohoku University, Japan

**Keywords:** PET, FFA, glucose

The purpose of this study was to investigate the relationship between exercise intensity and FFA and glucose uptake of skeletal muscle and myocardium with single photon emission tomography (SPECT) and Positron Emission tomography (PET), respectively.

Measurement of glucose uptake: 14 healthy subjects (30.4±6.2 years, mean±S.E.) participated this glucose study. Maximal aerobic power (VO<sub>2</sub>max) was 49.6±9.7 ml/Kg/min. Bicycle ergometer at three different workloads was used, 30, 55 and 75 % VO<sub>2</sub>max. 18F-FDG was injected 10 minutes after the beginning of exercise and total exercise time was 35 minutes. PET imaging started immediately after the exercise. Plasma radioactivity, glucose and lactate acid values were obtained during studies. Glucose uptake was measured in the quadriceps femoris muscle (QF) and in the myocardium. Measurement of FFA uptake. Six untrained subjects (20.2 ± 1.2 years) participated in the FFA study. VO<sub>2</sub>max was 52.5±2.1 ml/Kg/min. The study design was almost same as the glucose study. I123-BMIPP that is tracer of FFA was injected intravenously 5 minutes after the subjects started exercise. Single photon emission tomography (SPECT) measurements were started immediately after the exercise. QF glucose uptake increased significantly from 30% VO<sub>2</sub>max to 55% VO<sub>2</sub>max intensity ( $P < 0.05$ ), but not further during 75% VO<sub>2</sub>max intensity. QF I123-BMIPP uptakes at 40% and 55%VO<sub>2</sub>max intensity were significantly higher than that of 75%VO<sub>2</sub>max. Myocardial glucose uptake did not increase in a linear manner with increasing exercise intensity. At the highest exercise intensity glucose uptake decreased significantly as compared to both 30 and 55% intensity levels ( $p < 0.05$ ). There were no differences in I123-BMIPP uptake at each experiment in the myocardium. Plasma lactate concentration was strikingly increased according to the exercise intensity.

These results suggested that blood glucose and FFA were not the main energy source of skeletal muscle and myocardium to increase the exercise intensity in untrained subjects. At higher exercise intensity, intramuscular substrates, most likely glycogen would be the main energy source of the increment of exercise intensity. The increased myocardial energy that is needed during high intensity exercise is supplied by substrates other than glucose, like as lactate.

## S101B-4

**Protective effect produced by endurance exercise against maximal eccentric exercise-induced muscle damage**

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**Keywords:** isometric strength, elbow flexors, creatine kinase

It has been well documented that a single bout of unaccustomed eccentric exercise induces skeletal muscle damage, but confers protection against damage from subsequent bouts of the same exercise. This protective effect can last for more than 6 months following a bout of 24 maximal eccentric actions of the elbow flexors (24ECC), and is also evident when smaller numbers of eccentric actions are performed (Nosaka et al., 2001). Eston et al. (1996) showed that muscle soreness, strength loss, and increases in plasma creatine kinase activity after a downhill run were reduced when 100 maximal isokinetic eccentric actions were performed two weeks prior to exercise. This suggests that a different mode of exercise of the same muscle group conferred a protective effect, although the degree of protection was inferior to that produced by the same exercise mode. This study investigated the extent of protection conferred by a sub-maximal endurance task of the elbow flexors against 24ECC of the same muscle group.

Twenty-eight male students were placed into either ENDUR-24ECC (n=14) or 24ECC-24ECC (n=14) group. For the endurance task, subjects flexed (1 s) and extended (1 s) their elbow joint rhythmically for 30 minutes (900 actions) with a wristband load that was set at 10% of their maximal isometric strength (mean: 2.57 kg) determined at an elbow joint of 90°. ENDUR was performed 4-6 weeks prior to 24ECC, the latter consisting of 24 forcible extensions of the elbow joint from a flexed (90°) to an extended position (180°) in 3-s. Subjects in the 24ECC-24ECC group performed two bouts of 24ECC with their non-dominant arm separated by 4-6 weeks. Maximal isometric force, range of motion, upper arm circumference, muscle soreness, plasma creatine kinase, aldolase, and myoglobin were measured before, immediately after, and for 4 days after exercise. Changes in criterion measures following 24ECC were compared between groups by repeated measures ANOVA.

Significantly ( $P < 0.05$ ) smaller responses occurred for all measures for the ENDUR-24ECC group compared to the first 24ECC exercise in the 24ECC-24ECC group, however, the magnitude of the protective effect against 24ECC in the ENDUR-24ECC group was weaker than that of the 24ECC-24ECC group.

These results confirm that the protection against the effects of maximal eccentric exercise can be partially conferred in the elbow flexors using sub-maximal, endurance exercise with a minor component of eccentric exercise.

Nosaka K et al (2001). *Eur J Appl Physiol* 85: 34-40

## Oral Session

### Health and Fitness 1: Elderly

O101C

#### O101C-1

#### Evaluation of an exercise intervention on physical fitness in obese adults

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**Keywords:** physical fitness, obesity

Exercise intervention is mostly rough described, documented and evaluated in weight management programmes. In the original Optifast programme the focus lies on eating behaviour, whereas exercise lasts for 45min per week during the first 6 month and decreases till the end of the 52-week lasting therapy (Novartis Nutrition GmbH 2000). Meanwhile it is well documented that exercise in combination with diet is important to maintain weight loss (Wing 1999) and from Ross and Janssen (1999) we know that exercise alone can reduce weight in the same manner as diet alone. In this study we will evaluate the effect of this exercise program on physical fitness specially designed for obese adults.

Physical fitness was measured in 12 obese adults (50.2±9.6yr, 90.5 ±9.1kg, 34.1±3.5BMI, 41.7±6.3% fat) before and after the 4-month exercise intervention. The program took place 2x90min per week, each exercise lesson lasting for 90min. Altogether 21 lessons (25h13min) were completed. The program was focused on the improvement cardio-respiratory fitness (CRF), strength and mobility. Each lesson was documented via video for analyzing the content of the exercise intervention. We investigated CRF by measuring peak oxygen uptake (VO<sub>2</sub>peakm) with k4b2 using the modified Pennsylvania State protocol on the treadmill (Kukkonen-Harjula et al. 1998), estimated the CRF (VO<sub>2</sub>peake, FI, walking time) with the UKK-walk test (Laukkanen et al. 1992), measured strength as peak isometric force (PIF) for the right and left leg on a leg-press and determined mobility as balance with a one-leg stand on the AMTI force platform (closed eyes, right and left) using the path-length (m). T-test for paired samples was carried out for evaluating the impact of the exercise programme on physical fitness parameters.

Over 4-month 21 lessons were completed consisting of 23% motor tasks (walking and balancing a stick, playing a ball forward backwards; HR <100 bpm), 22% endurance tasks (walking, running; HR 120-150 bpm), 17% games (new games; HR 120-170 bpm), 14% strength (circuit training, exercises with own body weight) and 12% recreation tasks (stretching, tasks for body perception). The net exercise time per session was 79min, because of 12% spent for rests or explanations. Significant enhancement occurred in FI, walking time, PIF and balance.

We found that the here presented exercise intervention, characterized by tasks affecting mobility in general, lead to an increase in strength ability and balance. CRF increased tendentiously and shall be emphasized more in the following periods.

Barlow et al. (1995). *Int. J. of Obesity and Related Metabolic Disorders* 19, p. S41-S44.

Kukkonen-Harjula et al. (1998). *Scan. J. of Med. and Sci. in Sports* 8, p. 236-242.

Laukkanen et al. (1992). *Int. J. of Obesity* 16, p.263-268.

Lee et al. (1998). *Int. J. of Obesity and Related Metabolic Disorders* 22, p. S2-S7.

Novartis Nutrition GmbH (May 2000). *Das Optifast Programm* 52, München.

Ross and Janssen (1999). *Med. Sci. Sports and Exercise* 31 (11), p. S568-S572.

Wing (1999). *Med. Sci. Sports and Exercise* 31 (11), p. S547-S559.

#### O101C-2

#### Effects of self-controlled and external controlled training on physical perception, physical performance, and metabolic parameters in the elderly

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**Keywords:** elderly, self-controlled training, perceived fitness

Our study deals with the effects of different types of training control on psychological and biomedical training benefit in elderly. 16 healthy untrained older male participants (age 60-80, M=66.4, SD=5.6) were randomized to an experimental group and a control group, respectively. All participants carried out a 30 minute exercise program on a bicycle ergometer three days a week for a period of 10 weeks. Subjects of the experimental group were instructed to set the training intensity on their own - they were also allowed to take breaks. In contrast, subjects in the control group were instructed to hold a specific exercise intensity (individual performance [watt] at 2mmol lactate threshold) during the 30 minute exercise. Before and after the 10 week program health oriented parameters were assessed (e.g. BMI, LDL). Furthermore, before and after each of the 30 training sessions physical perception was measured using the Perceived Physical State Scale (PEPS).

We found main effects of time period on the extend of perceived physical state before and after exercising. All subjects feel more fit, more energetic and more healthy in time period II (6.-10. week) than in time period I (1.-5. week), both, before exercising and after exercising. In the PEPS dimension fitness we found an interaction effect group x time period: While the external controlled group show the same values in time period I as in period II, the self controlled group rates higher in period II than in time period I (F(1,14)=4.901, p=.044). We were able to observe the same tendency regarding the PEPS dimension flexibility (F(1,14)=3.483, p=.083). Regarding biomedical parameters we found a main effect of the training period on the subjects' performance (watt at 2mmol lactate threshold): All subjects improve their performance. Furthermore, we found a significant interaction effect group x time concerning LDL levels. While LDL decreases in the experimental group there is no significant LDL variation under the control condition (F(1,14)=7.998, p=.013). We found the same results concerning Cholesterin levels.

Our findings lead to the assumption that elderly benefit rather from a self-controlled training than from an external controlled training. Otherwise, it has to be discussed whether both, the given intensity for the control group and the way in which it has been computed, are likely to attain an optimal training adaptation.

## O101C-3

**Level of physical activity and demographic factors related to activity among elderly Norwegians**

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*Keywords: physical activity, elderly, demography*

It is well documented that physical activity is associated with improved quality of life and plays an important role in the maintenance of health and function in older people. However, less is known concerning the prevalence of and the socio-demographic factors related to physical activity. The aim of this study was to examine the level of physical activity among elderly people with regard to current Norwegian recommendations, and to examine demographic factors related to physical activity among elderly men and women.

A representative sample of 3770 Norwegian men (n=1810) and women (n=1960) between 65 and 97 years (mean age 75 years) completed a questionnaire. Physical activity was assessed by items adopted from The Physical Activity Scale for the Elderly (PASE, Washburn et al. 1993).

The response rate was 83.4%. Six percent of the subjects exercise on the recommended level (at least 30 min with moderate intensity 5-7 days/week), 22% exercise 3-4 days/week, 27% 1-2 days/week, and 45% do never engage in sport and recreational activities. Among those who exercise on the recommended level, the following gender differences were found: significantly more women than men were above 80 years ( $p<0.01$ ), were separated/divorced ( $p<0.01$ ), were widows ( $p<0.001$ ), had a lower income ( $p<0.001$ ), and were unmarried ( $p<0.001$ ). Out of the total sample the least active segment was the oldest old (> 80 years), those who have an illness and use medication, and individuals with lower levels of education and income. The low percentage of elderly people who exercise at the recommended level (6%) indicates a problem.

Since level of physical activity is related to health and quality of life, there is an obvious need for initiatives. The above data indicate how demographic factors are related to level of physical activity. This provides important insights for the design of effective interventions and activity programs in the future.

## O101C-4

**The influence of physical fitness and body composition by an intervention program based on walking in senior women**

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*Keywords: walking, physical fitness, elderly*

Physical fitness plays a crucial role in the involvement and interdependency of seniors in society. Fitness enables engagement and interaction with other people and thus influent their well-being and thus significantly contribute to their including in society. Age related changes in physical fitness (PF) and in body composition (BC) have implications for physical function and health. The redistribution and increase of fat and the loss of muscle mass results in substantial decrease in functional capacity and thus physical performance. Although BC and PF, as well as the age-related changes in them, have a strong genetic components,

they are also influenced by environmental factors like are nutrition, disease, and physical activity. From the dynamic activities that may be used by an influencing of these variables the walking is probably the most easily accessible, and often underestimated as a way to increase a subject's overall level of fitness and/or as a general tool for moving rehabilitation. The person's adaptation to walking is the highest from the all form of physical exercise that may be used for these goals. The aim of this study was to verify the moving programme based on walking for influence of body composition and aerobic fitness in women seniors.

The walking at a level of 50 to 70% VO<sub>2</sub>max (HR ranged from 65 to 90% of HR<sub>max</sub>) was used in a group of senior women (n=38, age=68.7±5.0 years, body mass=69.9±7.9 kg, height=161.0±4.9 cm, body fat=37.5±5.1 %, VO<sub>2</sub>max.kg<sup>-1</sup>=25.9.1±4.0 ml.kg<sup>-1</sup>.min<sup>-1</sup>). The duration of one exercise session ranged from 30 to 70 min, and was performed 3-5 times a week. The total time of walking exercise per week ranged from 90 to 250 min.

The energy output of realised walking activities ranged from 640 kcal (2675 kJ) to 1780 kcal (7740 kJ) [mean 950± 230 kcal - 3970±960 kJ] per week. After 12 months of training, the body mass was not altered, body fat was practically constant, and body cell mass was significantly increased (10±2.7 % -  $p<0.01$ ). Maximal oxygen uptake increased significantly by 8±3.3% ( $p<0.01$ ) of initial value. Similarly as in maximal oxygen uptake was significantly increased the physical performance in 1600 m walking test 7.8±2.5 % ( $p<0.01$ ) of starting value.

According to above presented data we may conclude that exercise with total energy content of 900 kcal (3760 kJ) during a week may be enough for reduction of age dependent changes in body composition, aerobic fitness and physical performance in senior women.

## O101C-5

**Weight reduction is feasible - one-year results of a randomised and controlled lifestyle intervention program with overweight adults**

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*Keywords: physical activity, overweight, lifestyle intervention*

To objectify the feasibility of a supervised lifestyle intervention program and the effectiveness of lifestyle changes on body composition and atherogenic risk factors, a randomised controlled study was performed with overweight adults.

89 subjects (BMI 27-35 kg/m<sup>2</sup>, 35-65 yrs) of both gender were included in a 48 weeks randomised parallel group comparison. Patients will be randomised to either a health education program alone (HEP group) or an initial six weeks dietary intervention followed by continuous dietary intervention (DI group) or a combination of a dietary intervention and a physical activity program (DIPA group) for 6 months. During the following stabilisation period of six months participants were regularly contacted by phone and interviewed about their outcome. All participants were re-examined 12 months after inclusion into the study. The dietary intervention consisted of a soy and milk protein supplement (Almased®). As primary efficacy parameter of the intervention body composition body fat was measured by the Bod Pod® technology. In addition, body weight, BMI, WHR, waist circumference, physical performance, parameters of the lipid metabolism and inflammatory markers

were documented to objectify the therapeutic benefit of the lifestyle intervention.

In all groups a significant decrease in body weight and fat mass ( $p < 0.001$ ) was observed. In addition, the therapeutic quality of the intervention programs can be interpreted as favourable, because body composition analyses showed that about 85% of the total weight loss can be explained by fat mass reduction. Comparing the results in the DI and DIPA group it has to be noted that the physical training offered twice a week played only a negligible role in the one-year success of this study. As expected the reduction in body weight was correlated with significant changes in atherogenic and metabolic risk factors also.

The results found emphasise that weight reduction is feasible in overweight adults and that the approached reduction in body weight is not inevitably correlated with a significant reduction in lean body mass. The data provide evidence that controlled and supervised lifestyle programs may minimise the fatal amount of body weight lost as fat-free mass during therapeutically induced weight loss and stabilise the regulation of weight control. However, the impact of dietary intervention on weight loss is more important than the impact of physical activity or health education alone.

*Ernst DE, Cleeman JI (2002). Curr Opin Lipidol 13: 69-73*

## O101C-6

### Workload corrections during arm and leg ergometry training in elderly people

**Terziotti Paolo, Pogliaghi Silvia, Balestreri Filippo, Cevese Antonio, Schena Federico**

Faculty of Sports and Motor Science, Italy

*Keywords: heart rate, training, workload*

Training prescriptions in the elderly are often limited to exercise intensity, frequency and duration. In daily practice,

trainers have little possibility to adjust workloads according to individual improvements. Ratings of perceived exertion (RPE) can be used (Borg, 1982), but direct monitoring of heart rate should be preferred.

17 healthy elderly individuals ( $66.2 \pm 4.4$  years) performed two incremental tests, with arm and leg ergometry, respectively. Ventilatory threshold (VT) was measured in both tests, to set up workloads (W) corresponding to 90, 100 and 110% of VT, for each subject. Selected target heart rates (THR) for each W were calculated. A 3 month, 3 days/week training program was completed by all subjects. Training sessions were divided into five consecutive steps: 7 min at 90%VT; 10 min at 100%VT; 3 min 90%VT; 5 min 110%VT; 5 min 90%VT, for a total duration of 30 min. Subjects were randomly assigned to two training groups, respectively using the arm (ARM) or the leg (LEG) ergometer. Heart rate was continuously monitored, and the last 30 s of each step were averaged. Workloads were adjusted after each 2-week training period, by averaging the two training sessions that attained the lowest HRs.

Averaged HRs were plotted against the respective workloads, to calculate the linear regression equation. Workloads were accordingly corrected, in order to retrieve the selected THRs. After training, all subjects improved their performance at given heart rates. Percent increase was:  $15.6 \pm 6.0$  ( $15.2 \pm 6.8$  ARM;  $16.1 \pm 5.4$  LEG) at 90%VT,  $12.3 \pm 5.0$  ( $13.0 \pm 5.9$  ARM;  $11.5 \pm 3.9$  LEG) at 100%VT,  $9.5 \pm 4.3$  ( $10.6 \pm 4.9$  ARM;  $8.1 \pm 3.5$  LEG) at 110%VT.  $p < 0.05$  100%VT vs. 90%VT,  $p < 0.05$  110%VT vs. 100%VT.

*Mazzeo R S and Tanaka H (2001). Sports Medicine, 31:809-818*

*Borg G A V (1982). Medicine and Science in Sports Exercise, 14: 377-81*

## Symposium

### Social Integration and Sport

### S101D

#### S101D-1

### Sport and integration policies in local, national and international public authorities: A critical analysis

**Vanreusel Bart**

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*Keywords: integration, social policy*

The objective is to examine the use of sports in integration policies of public authorities on different levels of governance. Based on the assumed potential and contribution of sports to social integration, public authorities increasingly adopt sport as a field of action with regard to social integration policies. Sport and social integration policies and practices are frequently observed in local policies of neighbourhoods, communities and cities, in integration objectives of different types of nationalism, and in integration policies of international bodies such as the European Union and United Nations. These sport and integration policies refer to sociological functionalism, a heavily criticized social theory. Based on observations of sport and integration projects on different levels, alternative and more viable theoretical perspectives on sport and social integration are formulated.

The study is based on personal observations, surveys and document analysis of sport and social integration policies and practices on four different levels:

- local observations and survey of sport and integration policies in an immigrant community town in Belgium
- a comparative document analysis on sport and social integration practices in a worldwide overview of sport for all developments in 28 countries (Dacosta & Miragaya, 2002)
- document analysis of sport and integration policies in charters and reports of the European Union.
- personal observation of sport and integration policies by the United Nations Unmik project (the post-conflict reconstruction project by the United Nations Mission in Kosovo).

Results of the combined observations and document analyses clearly show that sport is often, intensively and worldwide used as a means to contribute to aspired changes towards integration of underprivileged, towards resolving tension between groups and populations, towards building identities and towards stability and pattern maintenance in specific societies. The majority of policies and practices is based on the traditional functionalist paradigm as already developed by Parsons (1937). The basic theoretical assumptions are similar for local, national or international sport and integration projects. However, major critiques on this functionalist paradigm raise serious doubts on the effectiveness of sport and social integration policies. Thus a

contrast appears between common practices and policies on the one hand and criticized underlying social theory on the other.

In order to fundamentally support the sport and integration idea, alternative theoretical perspectives on sport and social integration need to be developed. Such perspectives include the development of an inclusive sport concept, a focus on a civil society building potential of sport, and the use of sport as a form of social empowerment.

Sport and integration policies and practices will increasingly be applied by local, national and international forms of governance by public institutions. However, in order to meet its objectives, a paradigm shift is needed from social functionalism to alternative supporting theoretical assumptions focusing on inclusive sport, civil society and social empowerment.

*Dacosta L, Miragaya A (eds), 2002, Worldwide Experiences and Trends in Sport for All, Oxford: Meyer & Meyer, 792p*

*Parsons T, 1937, The structure of social action, New York: Free press*

### S101D-2

#### **Social integration: legitimization for and effect of sport stimulation policies?**

**Elling Agnes**

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*Keywords: ethnicity, social integration, community sport*

In the last decades of the twentieth century, developments like increased immigration, pluralist value orientations, secularisation and individualisation have led to a perceived lack of social integration and social cohesion in society at large. Therefore the instrumental use of sport with its integrating potentials is increasingly promoted by (local) governments and (sport) organisations. Sport stimulation projects, especially community sport, are often mainly legitimated by claims that sport is a good instrument for socialisation of youth and social integration of ethnic minorities.

There is, however, little empirical evidence about all the ascribed positive integrating effects of sport participation. And in contrast to the view of sport as an ideal vehicle for social integration and inclusion, sport can also mirror or magnify differentiating and exclusion processes in broader society. Until recently the sports sector got away with vague statements about the supposed effects of sport stimulation projects, since everyone seemed to believe populist rhetorical slogans like 'sport fosters fraternization and social cohesion'. With an increasing development of quality management, including the necessity of monitoring and evaluating, and unstable economic prospects, sport organisations are increasingly pressured to give 'hard evidence' of promised social goals.

In my paper, I will present an overview of the literature on sport and social integration and some empirical results from an analyses of national and local sport stimulation policies (documents and interviews), a screening of several youth community projects in different Dutch towns and from questionnaires and interviews among youth. The results lead to the conclusion that the sport sector should be careful with using instrumental reasons like social integration as legitimization for sport stimulation and/or come up with more evidence of enhanced community cohesion and social integration of (young) people through sport participation.

### S101D-3

#### **Inclusion in sport - a gendered European perspective**

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*Keywords: gender, sport policy*

Sport for All is a rather young idea in modern society. The European Sport for All Charter was ratified in 1975 and relates to a comprehensive sports policy which attempts to extend to all sections of the community the beneficial effects of sport on health, social, educational and cultural development. With this document the European Council expresses the belief that all its member countries should foster inclusion of people into the sports system. The foci of this paper will be a) the Sport for All policy of non-governmental organisations on the one hand (federations, associations and clubs, i.e. non-profit organisations of the so called voluntary sector) and governmental agencies of the public sector on the other hand and b) the inclusion/exclusion of women. Physical activities are always intertwined with the structures, norms and ideals of a society, and the assumption is that they mirror that society's gender order and gender hierarchy. c) selected European countries - Norway, Great Britain, Germany, France, Spain and the Czech Republic.

There is a general lack of accessible and reliable surveys of the situation of women in sport and even if information about women's role in sport and its organisations is available, the language barriers are a major obstacle in preventing the dissemination of knowledge beyond a country or at least beyond a language group.

Thus the analysis is based on general findings and the central question will be: Are there any cross-cultural trends and common phenomena of inclusion and/or exclusion of women in sport? On the other hand: are there any variations or idiosyncratic developments and what do they tell us about the influences about the socio-cultural background?

We cannot directly compare the quantitative data of the countries because the methods of collection and measurement vary from country to country and even within most countries, surveys are neither standardised nor are they designed to produce comparative data over a defined period of time. At the same time we cannot directly compare most of the qualitative data, as the research was not intended to take a 'most similar system approach' and unearth the complex causal connections between cultural contexts, gender and sports development and the state. However, it is possible to identify at least some general trends, and many others that seem to be more regional in nature and tied up with specific cultures.

### S101D-4

#### **Inclusion policies and physical activity participation: A comparative study in two major cities with middle-aged adults**

**Tsiokos Dimitrios**

University of Leipzig, Germany

*Keywords: inclusion policies, sport opportunities, sport participation*

The European Charter appeals to the member states to initiate inclusion policies in order to make public physical activities accessible to all social groups. The main receivers of these political recommendations are the actors of the sport system. In this respect the system's actors should contribute to encouraging inclusion of further social groups. According to

HARTMANN-TEWS inclusion has always been the most important growth factor within a social system. To maintain its relevance and claim its establishment a social system should lay out its structures focusing mainly on inclusion policies.

This research investigates the differences and similarities of sports participation rates as an effect of the inclusion policies between two European countries. Furthermore this study covers a scientific lack in this scientific field.

## Oral Session

### Rehabilitation

O101E

#### O101E-1

#### Test-retest reliability of postural stability tests in uninjured and in patients after ACL reconstruction

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LIKES Research Center, Finland

*Keywords: postural stability*

The purpose of this study was to investigate reliability of three different postural stability tests after anterior cruciate ligament reconstruction (n=15) and in uninjured subjects (n=20) using force platform.

ACL was reconstructed 3 to 12 months before the tests. Participants completed a series of three stance variations (feet apart, feet together and single leg stand without shoes) while standing on a force platform (Good Balance, Metitur Ltd, Jyväskylä, Finland) with eyes open. All subjects were retested three days later. Feet apart (FA) and feet together (FT) tests (30 s) were done twice and single leg stand (SLS) tests (20 s) three times per session (both limbs). The best result of each set was used. As the outcome measures we analyzed mean velocity (mm/s) of the center of pressure on the force platform in anterior-posterior direction (ap) and in medial-lateral direction (ml). The results were evaluated with intraclass correlation coefficient (ICC), coefficient of variation (CV%) and with paired T-test.

ICCs of various tests in uninjured subjects were: FAml 0.75, FAap 0.62, FTml 0.78, FTap 0.91, SLSml dominant 0.56, SLSap dominant 0.73, SLSml non-dominant 0.73, SLSap non-dominant 0.90. The corresponding ICCs in ACL-group were: FAml 0.65, FAap 0.57, FTml 0.73, FTap 0.52, SLSml unoperated 0.74, SLSap unoperated 0.74, SLSml reconstructed 0.55, SLSap reconstructed 0.59. All ICCs between test and retest were statistically significant ( $p < 0.05$ ). According to ICCs the reliability of these tests seemed to be weaker in ACL-group than in uninjured subjects, especially when standing on the involved limb. CVs in uninjured group varied from 5.4 % to 9.0 % and in ACL-group from 5.0 % to 8.8 %. The difference between the groups wasn't observed in CVs. Both groups improved their performance in single leg stand during the retest. The improvement was significant ( $p < 0.05$ , T-test) in ap-velocities in both limbs of uninjured subjects and in unoperated limb in patients after ACL reconstruction.

These results suggest that postural stability can be measured reliably with Good Balance force platform in uninjured subjects and in patients after ACL reconstruction. However, the measurements were more reliably in uninjured subjects than in the operated patients. To enhance reliability more than three consecutive trials should be used in single leg stand. The variation in single leg stand on the reconstructed limb can be related to changes in proprioception after ACL reconstruction.

#### O101E-2

#### Intensive physical training in post-operative elderly patients

Suetta Charlotte, Magnusson Peter, Røstø Anna, Aagaard Per, Jacobsen Ane, Dalgas Ulrik, Berget Jakob, Duus Benn, Kjær Michael

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*Keywords: elderly, resistance strength training, post-operative*

It is well known that immobilisation due to hospitalisation and major surgery is causing severe decline in both muscle mass (Bloomfield 1997, Häggmark 1981), muscle strength (Wigerstad-Lossing 1988) and muscle function. Despite the prevalence of musculoskeletal diseases that require surgery in the elderly, regimes for optimal rehabilitation remains unknown. The purpose of this study was to compare the addition of unilateral Resistance Training (RT) or Electrical Stimulation (ES) of the quadriceps muscle to a Standard Rehabilitation (SR) program after hip-replacement surgery.

Thirty-seven patients (60-86 yrs) scheduled for unilateral hip replacement due to arthrosis were randomised to either 1) RT (3/wk×12 wks), 2) ES (1 h/day×12 wks) or 3) SR (1 h/day×12 wks). Patients were tested pre-surgery, 5 and 12 wks post-surgery. Measurement outcomes were; Length of Stay in hospital (LOS), quadriceps muscle Cross-Sectional Area (mCSA), maximal isometric muscle strength and muscle function. Non-parametric tests were used for statistical analyses (significance level,  $p < 0.05$ ).

At the onset of the study there were no differences between the three groups with respect to anthropometric data, comorbidity, muscle strength, pain or functional performance. LOS was significant shorter in the RT-group (10 days  $\pm 2.4$ ,  $p < 0.05$ ) compared to the SR-group (16 days  $\pm 7.2$ ). A significant increase in mCSA (12%,  $p < 0.05$ ) and muscle strength (24%,  $p < 0.05$ ) was observed in the RT-group in contrast to the ES-group and SR-group. Both, RT-group (30%,  $p < 0.001$ ) and ES-group (15%,  $p < 0.05$ ) improved functional muscle performance more than the SR-group.

These data demonstrate that postoperative resistance training effectively increases maximal muscle strength, muscle mass and muscle function compared to a standard rehabilitation regime. The data also indicates that early intervention with physical training markedly reduces LOS in elderly postoperative patients.

Bloomfield et al (1997). *Med Sci Sports Exerc.* 29:197-206

Wigerstad-Lossing et al (1988). *Med Sci Sports Exerc.* 20:93-98

Häggmark et al (1981). *Int J Sports Med.* 2:12-17

## O101E-3

**Effects of an aerobic endurance training on autonomic dysregulation in patients with anxiety and somatization disorders**

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**Keywords:** *aerobic endurance exercises, autonomic nervous system, somatization*

A substantial number (15-20%) of patients with anxiety and somatization disorders shows dysfunctions of the autonomic nervous system. We therefore examined, whether aerobic endurance training improves these dysfunction. In addition, psychological benefits of aerobic exercise are expected.

Autonomic dysfunction is operationalized as impaired baroreflex sensitivity (BRS) derived non-invasively from spectral analysis of heart rate and blood pressure. Negative affect, anxiety, complaints, and somatization traits are assessed in questionnaires. Patients are recruited at the beginning of an inpatient rehabilitation program. After a first assessment of autonomic status and cardiovascular fitness (ergometer lactate test) (T1), four groups are formed. Half of the patients with (BRS < median) or without (BRS > median) autonomic dysfunction are randomly assigned to either the control or the experimental group. The two control groups (with and without dysfunction) are treated with the standard rehabilitation program. The two experimental groups participate in an additional aerobic exercise training (3 times a week > 30 min mainly jogging outdoors, supervised by an exercise instructor). After a 4-week rehabilitation the initial assessment is repeated (T2) to assess short term effects. Subjects are asked to continue the endurance training in the same intensity on their own at home. Monthly phone contacts combined with an instruction manual and training intensity reports are included to promote compliance to the training. Six months later a third assessment (T3) describes long term changes. A total of 130 patients will be included.

Preliminary results on 71 patients reveal a beneficial effect of exercise on reactivity to mental challenge. The changes in baroreflex-sensitivity, heart rate variability, blood pressure, and heart rate all are significantly lower during the stress test in the trained experimental group with unimpaired autonomic regulation. Patients of the experimental group also have significant improvements in depression and anxiety.

We conclude that systematic aerobic endurance training leads to clinically important additional improvements in symptoms and complaints in patients with anxiety and somatization disorders during a psychosomatic rehabilitation program which is mainly based on cognitive behavioural interventions. Endurance training also improves autonomic balance during mental stress.

## O101E-4

**Heavy resistance exercise improves strength, function and self-reported health in patients with chronic obstructive pulmonary disease**

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**Keywords:** *muscle strength, resistance exercise, lung disease*

Existing evidence suggests that loss of muscle mass and consequently strength resulting from inactivity contributes to

the reduced physical capacity in patients with chronic obstructive pulmonary disease (COPD). The purpose of this study was to investigate if heavy resistance exercise could increase muscle mass, muscle strength and power, and improve function and self-reported health in older males with COPD.

Home-dwelling male patients (65+ yr) were recruited from the out-patient lung clinic. Baseline assessments included: Forced expiratory volume (FEV1), cross-sectional area of quadriceps (CSA), isokinetic strength in knee extensors/flexors (KES/KFS), leg extension power (LEP), maximal gait speed (MGS), stair-climbing time (ST), self-reported level of ADL (ADL) and health. The subjects were subsequently randomised to a resistance exercise group (RE, training twice weekly for 3 months) and a breathing exercise group (BE, control group) and assessments were repeated after 3 months.

6 (RE) and 7 (BE) completed the project. No significant differences existed between the groups on inclusion. In RE the following parameters increased (pre to post, mean±SD): CSA (3571±439 to 3776±488 mm<sup>2</sup>, p=0.005), KES (64.7±19.5 to 76.2±20.2 Nm, p=0.013), LEP (2.0±0.6 to 2.3±0.7 W/kg, p<0.0001), MGS (1.63±0.4 to 1.95±0.5 m/s, p=0.016), and ST improved (4.77±1.39 to 3.93±0.98 s, p=0.028). KFS and FEV1 did not improve in RE. In BE no improvements were found and FEV1 tended to decrease (p=0.058). The ADL level was significantly better in RE than in BE at 3 months i.e. walking 400 m (p=0.011), climbing stairs (p=0.011) and carrying 5 kg (p=0.048). Self-reported health improved in RE (p=0.046) and was significantly better than in BE at 3 months (p=0.035). In BE no improvements were found.

Heavy resistance exercise was well tolerated by these relatively frail elderly COPD patients. The improvements in muscle strength, power and functional performance as a result of the three months resistance exercise were clinically relevant. Furthermore, resistance exercise resulted in a significantly improved perception of health and may slow down the decrease in FEV1 in elderly male patients with COPD.

## O101E-5

**Foot loading patterns in patients with idiopathic scoliosis during gait**

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**Keywords:** *gait, idiopathic scoliosis, foot loading*

Idiopathic scoliosis is a complex deformity of the back that results in gradual collapse and twisting of the spinal column (e.g. Burwell et al 1992). This deformity may lead to an asymmetry of the neuromusculoskeletal complex that might depend on convexity of the spinal curvature (Giakas et al 1996). The deformity may also result in a foot loading asymmetry and this asymmetry may depend on the convexity of the curvature. Therefore, the purpose of the study was to examine possible differences in foot loading patterns between legs during gait.

This study included 16 patients suffering from idiopathic scoliosis. The scoliosis was classified as thoracic in five patients and as double major curve in 11 patients. The average Cobb angle for the thoracic group was 31.6 ± 10.5°. The average thoracic and lumbar curves of the double major scoliosis were 36.8 ± 6.6° the 29.6 ± 12.7°, respectively. The convexity of the spinal curve in the thoracic group and the



convexity of the lumbar curve in the double major curve group were considered as affected side. Two force plates were used to record ground reaction forces (GRF) and an in-shoe pressure data-acquisition system was used to measure the distribution of plantar pressure simultaneously with the EMG recordings during gait. The EMG was recorded from the upper and lower back muscles at both sides of the spinal column. The average walking speed was  $1.87 \pm 0.1$  m/s.

Regardless of asymmetry of the EMG activity patterns between the scoliotic curvatures of the spine, bilateral comparison revealed no significant differences in any plantar pressure and GRF parameters among examined patients.

The statistical analysis demonstrated no systematic differences in the plantar pressure distribution and GRFs responses between the limbs. This bilateral symmetry in the foot loading responses supports an earlier study by Giakas et al (1996) who did not find any differences in the time domain analysis of the GRF. Thus, spinal deformities may have more complex effects on the neuromusculoskeletal function of the limbs. Consequently, some compensation mechanisms may mask their occurrence in the measured foot loading parameters. The results also indicate that the effects of this disorder on the gait patterns cannot be evaluated satisfactorily by the present methodology.

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Giakas G et al (1996). *Spine* 21: 2235–42.

#### O101E-6

### Modification of Barthel Index in order to increase the reliability of the instrument

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**Keywords:** daily living activities, Barthel index, modification

The original Barthel index (OBI) specifically measures the degree of assistance required by an individual on 10 items (feeding, bathing, personal toilet, dressing, bowels, bladder, toilet transfers, transfers- chair and bed, ambulation, stair

climbing) of mobility and self care of basic activities of daily living (ADL). The global score, ranging from 0 to 100, is calculated from the sum of all estimated individual item scores. Levels of measurement in each item are limited to either complete independence or need assistance of a category of 5 points. Each point is not clearly appointed by instructions. So, there is a lack of clarity and completeness in testing procedures. The main aim of the study was to modify the OBI specifying estimation of each activity performed within every one of the 10 items of ADL with exactness of scoring in 1,0-0,5 points. The validity and reliability of the modification should be verified too.

The modification was based on the ranking method along the hierarchical organization of difficulties in performing each of the activities within every item of ADL using the following principle - high positions for activities with difficulties in performance. The scoring of performed activities was also dependent on using compensatory means, special equipment and human assistance. General calculation of every item in modified Barthel index (MBI) was made according to the specific formula.

It was defined as the construct validity of MBI because the common scores of MBI significantly differ between groups of low paraplegia and tetraplegia ( $p < 0,001$ ) as well as between low and high paraplegia ( $p < 0,05$ ). The intraclass reliability coefficient, determined by the test-retest a day separated method (used by the same scorer) for MBI was significantly higher than for OBI (0,92 and 0,52 correspondingly). The intertester reliability (objectivity) coefficient, verified by test-retest the same day method performed by two different testers for OBI was very low (0,24) compare with the high objectivity of MBI (0,84).

Therefore the MBI could be used for scientific investigation of biosocial functions and practical use for definition of degree of assistance for outpatient services because it is valid, stable and objective.

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Guccione A, Cullen E, O'Sullivan B (1988). *Functional Assessment*, 219-35.

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## Symposium

### Muskuloskeletal Loading during Human Locomotion: Direct and Indirect Approaches

S101F

#### S101F-1

### General kinetics of the musculo-skeletal system

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**Keywords:** human movement, inverse dynamics, internal forces

While estimating intersegmental loads (ILs), the quantities that can normally be measured are: skin point position (stereophotogrammetry), external loads (ELs) (dynamometry), and anthropometric quantities. The anthropomorphic models are based on a kinematic chain of rigid links. The number of links and constraints imposed by the joints determine the number of dof of the model and its faithfulness to reality. The mechanics is described by the equations of motion that contain quantities related to position and orientation, relevant first and second derivatives, mass,

location of the centre of mass and inertia tensor, for each link in the model. Of course, the mathematical model thus obtained may be determined, over-determined or under-determined depending on the available input variables and parameters. The approach, among the three options, chosen by the analyst is based on a trade off between economy and accuracy. The relationship between the available information and the accuracy with which the mechanics of a motor act may be described is expounded upon. The accuracy of the ILs estimates cannot be directly assessed. However, ELs might be used to this purpose, since they can be measured with high accuracy. The average rms difference and correlation coefficient between the estimated and measured EL components provided a measure of the estimation accuracy. These quantities were determined while using stereophotogrammetric data and both 3-D and 2-D models with different dof. If both kinematic variables and ELs are measured over-determined equations are obtained. These may be solved using optimization approaches which

use objective functions embedding the above-mentioned rms differences. In this way, the accuracy with which ILs are estimated can be improved. Another possible scenario involves having no information about movement but only measured ELs. Equations of motion are therefore under-determined. In this case an optimization algorithm can allow the estimation of the model kinematics and, therefore, the ILs.

The accuracy with which this can be achieved is similar to that obtained using the same physical model and stereophotogrammetric data. A further problem, worthy of discussion, is the possibility of interpreting the intersegmental couples as musculo-ligamentous moments. This closely depends on the point of reduction used to represent the IL. If the involved joint has a stationary centre of rotation, then this may effectively be used as reduction point. For other joints, the solution of this problem calls for still more complex modelling exercises.

### S101F-2

#### Measurement of external forces

**Berne Necip**

The Ohio State University, United States

*Keywords: force measurement, force plate, transducers*

Generally, multi-component load transducers are used to measure external forces in biomechanical studies. Cunningham and Brown (1952) built the first six-component force plate, as well as the first six-component "pylon" transducer. The latter was used to measure loads transmitted at the shanks of lower limb prostheses. The first commercially available force plates on the other hand utilized piezoelectric load transducers, and were introduced to the marketplace in the early 1970's. About a decade later strain-gaged force plates also became commercially available. Regarding the technology, there are design differences between commercially available force plates. Piezoelectric devices use quartz crystal disks to measure the three force components at the four corners of the force plate, while strain-gaged force plates use variations on the Cunningham and Brown (1952) design: four cylindrical pillars are gaged to measure the three force and three moment components. Calibration information for each strain-gaged force plate is given in the form of a six-by-six matrix. Also, there are some differences between the force plates of different manufacturers.

A recent development in multi-component transducers is the introduction of "smart" devices. This is perhaps the first real technological advancement since the commercialization of force plates. In such a plate the strain gage outputs are digitized inside the force plate, and the output is given as calibrated force and moment values without any cross-talk. The same technology has also paved the way for building a matrix of small force plates forming an instrumented larger floor surface at a reasonable cost. It is expected that such a design will facilitate testing subjects/patients without having them target the force plate. It is also expected that when a subject steps on the array of force plates, intelligent software will select active plates and form separate virtual plates under each foot of the subject.

*Cunningham, D. M. and Brown, G. W., (1952), Proc. SESA, 14(2), pp 75-90.*

### S101F-3

#### Direct in vivo measurements of human tendon and ligament forces

**Komi Paavo V**

University of Jyväskylä, Finland

*Keywords: muscle mechanics, tendon forces, measurement techniques*

Information on the forces produced by individual skeletal muscles, tendons and ligaments is important to the understanding of muscle mechanics, muscle physiology, musculoskeletal mechanics, neurophysiology and motor control. Two direct techniques have been developed to study tendon and ligament forces in human locomotion: buckle transducer technique (Komi et al 1987) and optic fiber technique (Komi et al, 1996). Application of the buckle transducer, e.g. around the Achilles tendon, is more invasive and requires surgical implantation under local anaesthesia. Measurements can then be performed for approximately 2-3 hours, depending on the quantity of local anesthesia applied, and movements can vary from slow walking to maximal jumping.

Use of the buckle transducer produces important parameters such as peak-to-peak force and rate of force development which can then be used to describe the loading characteristics of the tendon under normal locomotion. When these parameters are combined with other external measurements, such as cinematography for calculation of muscle tendon complex length changes, the important concepts of muscle mechanics, such as instantaneous length-tension and force-velocity relationships can be examined in natural situations such as stretch-shortening cycle (SSC) activities (e.g. Komi, 1990). Simultaneous recording of EMG activity can add to the understanding of the force potentiation mechanism during SSC type movement.

The buckle transducer method is naturally quite invasive. Other restrictions in the use of this method are difficulties in the calibration procedure and problems in the application of the technique when long term and repeated implantation may be of interest.

To overcome some of the disadvantages of the buckle transducer technique, an optic fiber method has recently been developed (Komi et al, 1996). The measurement is based on light intensity modulation by mechanical modification of the geometric properties of the plastic fiber. The optic fibre can be inserted through the tendon with a hollow 19 gauge needle.

The optic fiber method may not be more accurate than the buckle method but it has several advantages. It is much less invasive and can be reapplied to the same tendon and ligaments after a few days of rest.

*Komi (1990) J. Biomech. Vol. 23, Suppl.1: 23-34, Komi et al (1987) Int. J. Sports Med. 8 (Suppl.): 3-8, Komi et al (1996) Eur. J. Appl. Physiol. 72: 278-280, Salmons (1969) Bio. Med. Eng. 4: 467-474*

### S101F-4

#### Estimate of the internal forces

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*Keywords: musculoskeletal loading, fracture healing, joint replacement*

In biomechanics, a great deal of research has been conducted in an effort to characterize the mechanics and interaction of the soft and hard tissue structures.

Unfortunately, many investigators tend to treat the muscles and bones as separate and independent structures. However, in order to fully understand how loads are transmitted within the body the mechanical interaction of these structures must be considered. An example of the complex inter-relation of the soft and hard tissue structures are the long bones of the upper and lower extremities. For the lasting function of an artificial joint or for the reconstruction of fractured bones the mechanical loading of the biological tissue is essential: Implants may fail under peak or fatigue loads and the biological healing or adaptation process is triggered by mechanical stimuli.

Therefore, numerous studies have been performed to examine the mechanical conditions of the musculo-skeletal system of the upper and lower limb. Only seldom these investigations incorporated the bones with their muscular and

ligamentous structures. Because of its importance in the musculo-skeletal system, a complete understanding of the load situation in a bone is of particular interest.

It is explained how to calculate the load conditions in long bones of the lower limb. The unknowns associated with these calculations are the muscle, ligament and joint contact forces; in addition the exact anatomy is seldom known. Joint contact and ligament forces may be determined from in vivo and in vitro experiments. Muscle forces can be estimated by mathematical models, direct measurements requires the monitoring of the electromyographic activity. The literature on these measurements and calculations will be reviewed; the techniques used in the computation of internal loads are formulated.

## Symposium

### Peripheral and Centrally Organized Activation in Motor Learning

S101G

#### S101G-1

#### Spinal modulation of short latency reflexes during walking

**Faist Michael, Hodapp Maïke, Klisch Cornelia, Berger Wiltrud**

University of Freiburg, Germany

*Keywords: gait, reflex modulation, plasticity*

The neuronal networks underlying the generation of rhythmic motor patterns are extremely flexible and can adapt rapidly to changes in external conditions (Pearson 2000). In healthy subjects short latency leg muscle reflexes are rhythmically modulated and depressed throughout the step cycle by a corresponding rhythmic modulation of spinal mechanisms. In ballet dancers H reflexes are depressed suggesting that training may influence their function. In spinal spasticity reflex modulation is disturbed. After unilateral cerebral lesions the modulation pattern is preserved suggesting that the unaffected side can provide control of spinal reflex pathways bilaterally and that part of the modulation is supraspinal in origin. In diplegic children with cerebral palsy the bilateral lesion occurs before complete maturation of the cortico-spinal tracts (CST). Comparison of these patient groups may allow to identify the origin of the modulation.

Hoffmann (H-) and tendon jerk (T-) reflexes were investigated during walking on a treadmill in 10 adult hemiparetic patients, in 10 healthy control subjects, in 9 diplegic children with cerebral palsy aged 7-16 years and a control group of 36 age matched healthy children. The results are compared to data of patients with spinal lesions.

In healthy subjects soleus T- and H-reflexes were modulated in a similar fashion with a maximum at the end of stance and a depression during swing phase. A similar modulation was present in hemiparetic patients. In healthy children the rhythmic modulation is similar to adults already at the age of 7 years. The reflex size decreased with age continuously until the age of 14 years where the depression reached the level of adults. A similar rhythmic modulation was present in all diplegic children but with increasing age no decrease in reflex size occurred. The rhythmic pattern is present before the maturation of the CST is completed while the reflex depression develops later.

The rhythmic reflex modulation requires an intact spinal cord whereas the general reflex depression during gait depends on intact CST of at least one side which may contribute to the depression bilaterally. The rhythmic modulation is located

spinally or at the level of the brainstem. The tonic depression may be located in higher centres and may play a role in motor learning as it increases in parallel with the maturation of the CST in children and as it is influenced by habitual activity.

#### S101G-2

#### Muscle afferent contributions to human walking

**Grey Micheal**

Aalborg University, Denmark

*Keywords: walking, afference*

Sensory feedback contributes to the motor control of human walking in two fundamentally different ways. During the stance phase of the step cycle, the ankle extensors undergo an eccentric contraction and a coincidental increase in muscle spindle and Golgi tendon organ discharge. This increased afferent activity contributes to the preprogrammed motoneuronal drive thereby reinforcing the ongoing locomotor muscle activity. When the normal trajectory of the leg or foot is disturbed, sensory feedback can also provide an important "error signal" for the generation of a corrective reflex response. In this presentation, I will review some of our recent studies that have attempted to elucidate the contribution of sensory feedback to the control of the ankle extensors during the stance phase of the step cycle. In particular, some of the differences between corrective reflex responses and normal afferent feedback will be highlighted.

If the ankle is unexpectedly disturbed by a fast dorsiflexion perturbation, a triphasic reflex response is usually observed in the plantar flexor EMG with an onset latency of about 40 ms. This response consists of a spinal group Ia pathway, a spinal group II pathway, and a transcortical pathway. These reflex responses are modulated with the background EMG activity and may not be evoked in the swing phase when the plantar flexor muscles are not active.

One way to investigate the contribution of sensory information to the control of normal walking is to remove it. This can be done by applying a fast plantar flexion perturbation to unload the muscle-tendon complex and temporarily cease the firing of spindles and GTOs. This produces a drop in the m. soleus EMG activity with an onset latency of approximately 60 ms, implicating medium diameter

fibres. Another way to investigate this sensory information is to slightly modify the normal trajectory of the ankle. When the natural dorsiflexion during stance phase is enhanced or reduced, the m. soleus EMG activity increases or decreases, respectively, in proportion to magnitude of the trajectory modification.

The contribution of sensory feedback to the corrective reflex response is now fairly well established. However, there is still a considerable amount of study needed to understand how afferent feedback contributes to normal walking. The techniques outlined in this talk show may shed more light on these complex mechanisms.

The Danish National Research Foundation is acknowledged for financial support.

### S101G-3

#### **Neural control of walking: cues from kinematics, electromyography and proprioceptive manipulation**

**Schieppati Marco, Courtine Gregoire**

University of Pavia, Italy

*Keywords: EMG, locomotion, curved walking*

Three levels of neural organization will be considered: spinal level of central pattern generator (CPG) with sensory feedback from proprioceptive and cutaneous inputs; supraspinal modulations, either tonic or phasic; higher centres adaptations for skilled locomotion. Locomotion is frequently studied in conditions such as straight-ahead walking, often on a treadmill. The question of adaptation to asymmetric progression, as walking along a continuously curved path, is addressed here, in order to gain insight into the neural organisation of walking.

Subjects reproduce both trajectories with both eyes open and closed. Stride length is unchanged for the outer, but decreased for the inner leg. The feet anticipate body rotation by pivoting toward the inner side. A shift of body centre of mass toward the inner side accompanies turning. In general, changes in the amplitude of head, trunk and feet movements are well related to the kinematics of the steering body.

There is a phase lag in limb displacement between the inner and outer leg. Swing velocity is greater for outer than inner foot. The duration of the stance phase diminishes and increases in the outer and inner leg, respectively. Leg muscle EMG recording shows that the same rhythm is propagated to both legs, in spite of inner and outer strides diverging in length. The soleus burst during stance increases in the outer and decreases in the inner leg, without changes in timing. Tibialis burst increases on both legs during the swing phase; it is advanced on the outer and delayed on the inner side. Peroneus burst decreases in both legs, but more in the inner than the outer leg, and lasts longer in the inner leg at the onset of the swing. Closing the eyes does not affect gait pattern and muscle activity. The command to walk along a curved path seems therefore to exploit the basic mechanisms of the spinal locomotor generator, thereby limiting the computational cost of turning. The specific role of the various sensory modalities in the reflex control of locomotion is also considered. Bilateral continuous soleus muscle vibration induces only minor changes in duration and length of stance and swing phase and on speed of walking and kinematics of lower limb segments. This speaks for a selective gating of Ia input during locomotion.

On the other hand, unilateral vibration applied to the neck makes the body trajectory to deviate. These effects do not imply body tilt or inclination, nor do they threaten equilibrium. The asymmetric neck input would modify the reference frame for walking.

## Symposium

### **Physical Fitness and Health: Epidemiology**

**S101H**

#### S101H-1

#### **Political implications of the epidemiology of physical activity - experiences from a "second generation" country**

**Martin Brian, Mäder Urs, Marti Bernard**

Federal Office of Sports, Magglingen, Switzerland

*Keywords: epidemiology, HEPA, public health*

The importance of health-enhancing physical activity HEPA has been discussed more widely in Switzerland since 1995. Based on experiences from other countries, attempts have been made to obtain national epidemiological data.

A first review of a number of local studies was published in 1995. The Swiss Health Survey, a large population survey conducted by the Swiss Federal Statistical Office every five years, has used a physical activity item since 1992. The supplementary Swiss HEPA survey 1999 activities of moderate intensity and intention for behavioural change were assessed for the first time. The Swiss HEPA survey 2001 has repeated these measurements and additionally used a new set of items (Martin 2002).

Already the 1995 review has produced the rule of thumb of "1/3 inactive, 1/3 partially active, 1/3 sufficiently active" for physical activity in the Swiss population. The data from the 1992 Swiss Health Survey which were published in 1997 have basically corroborated these assumptions and have

delivered the first associations between physical activity and health indicators for the Swiss population in cross-sectional data. The 1997 Swiss Health Survey has shown a 4 percent increase in inactivity over the five years before. The 1999 HEPA survey has produced the first activity prevalences that could be correlated directly to the new HEPA recommendations: 37% of the interviewees were regarded as inactive. Based on these assumptions, the negative effects of physical inactivity for Switzerland were estimated to add up to 1.4 million cases of disease, almost 2,000 deaths and direct treatment costs of 1.6 billion Swiss francs (1.1 billion euro) annually. The HEPA survey 2001 has shown no difference in the prevalence of inactivity in comparison to 1999 when using the same items, but a higher percentage of inactive individuals when using another less suggestive set of items (58%).

Switzerland has established physical activity monitoring with the Swiss Health Survey as its backbone. Additional studies allow the exploration of more specific questions. The country-specific data have been and will still be an important element in the political process leading to a better recognition of the importance of HEPA on the national level.

*Martin BW (2002). Schweiz Z Sportmed Sporttraumatol 50 (4): 164-168*

## S101H-2

**Measurement of health-related physical activity and physical fitness**

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University of Tampere, Finland

*Keywords: health-enhancing physical activity, health-related fitness, assessment*

Health-enhancing physical activity (HEPA) and health-related fitness (HRF) are new concepts developed primarily in the 1990's based on research evidence on the relationship between physical activity, fitness and health. The new concepts pose a challenge for the research community to develop relevant assessment methodology.

IPAQ, the International Physical Activity Questionnaire, is a recently proposed set of questionnaires for the assessment of HEPA.

The new instruments assess the total amount of weekly vigorous and moderate-intensity physical activity covering its all domains, i.e. work/education, transport, domestic chores and recreation. In addition the amount of weekly walking and sitting are assessed. Eight versions of the instrument were tested for feasibility, reliability and validity. The test-retest reliability coefficients varied between fair and excellent indicating in general an acceptable repeatability. Criterion validity coefficients between the total weekly physical activity in MET minutes and the total weekly CSA-accelerometer counts indicated agreement similar to earlier physical activity questionnaires. Another series of studies was conducted to evaluate the measurement properties of potential health-related fitness tests with the purpose of developing a scientifically sound HRF test battery. The UKK Walk Test was shown to be reliable, valid and sensitive test for the assessment of cardio-respiratory fitness of adults. Recently, a more versatile HRF test battery, including also musculo-skeletal and motor fitness tests, have been developed and evaluated.

The results indicated that the proposed test battery is a reliable, safe, feasible and valid field method for the assessment of health-related fitness among adult populations.

Health-enhancing physical activity and health-related fitness have become important ways to promote public health. The new theory-driven and scientifically developed assessment methods provide promising tools for their assessment as part of research and promotion of health-enhancing physical activity.

## S101H-3

**IPAQ and accelerometry in the measurement of physical activity - data and experiences from population studies**

Sjöström Michael, Yngve Agneta, Hagströmer Maria

Karolinska Institutet, Stockholm, Sweden

*Keywords: physical activity, monitoring*

The International Physical Activity Questionnaire (IPAQ) has been developed by a global working group of physical activity researchers (Craig et al., 2003; [www.ipaq.ki.se](http://www.ipaq.ki.se)). The questionnaire has been tested all over the world and is now recommended for use in national population based prevalence studies. IPAQ has already been, and will continue being used in international population studies.

Results: a) Eurobarometer Study. Since 1973, the European Commission has been monitoring the evolution of public opinion in the Member States. In autumn 2003 the chosen

topic was health, including physical activity. Items from IPAQ short version were selected. One thousand individuals per country were interviewed. The data collected have been preliminary analysed and show how the total activity varies in between countries, and that the activity pattern all over Europe is dramatically different from that of exercise habits. About one third of the population seems to be insufficiently active. b) The International Physical Activity Prevalence Study (IPS) was commenced in 2002 to demonstrate the feasibility of using IPAQ to collect nationally representative data on physical activity, and is currently running with about 20 countries participating. The random sample in each country is about 1300 individuals. A scoring protocol has been developed to facilitate analysis and make data handling and presentation in between different centres/countries comparable. There is also increasing interest in the contextual (environmental) barriers that prevent or limit the opportunity to walk and cycle. The IPS has developed an optional Environmental Module, in addition to the IPAQ, to assess the environmental factors for walking and cycling. Data collection is currently in progress.

This new development gives new insights into how, and to what extent, people are active. It raises a number of issues regarding lifestyle physical activity: Is it the total time spent in moderate intensity, or is it the time achieved as continuous bouts that is important for public health purposes? There is obviously a need for a discussion about the current recommendation for health enhancing physical activity.

*Craig, Marshall, Sjöström, Bauman, Booth, Ainsworth, Pratt, Ekkelund, Yngve, Sallis, Oja; International Physical Activity Questionnaire: 12 country reliability and validity. Med Sci Sports Exerc 35, (August issue, pre), 2003 (in press)*

## S101H-4

**Spontaneous changes in physical activity and its predictors in the Swiss Household Panel (SHP)**

Zimmermann-Sloutskis Dorith, Martin Brian, Marti Bernard, Allison Ken, Zimmermann Erwin

Institute of Sport Science, Switzerland

*Keywords: inactivity*

The importance of physical activity on health is widely recognized. Inactivity, independently of obesity increases the risk of cardio-vascular diseases, osteoporosis, and cancer and reduces the quality of life. Inactivity is higher in female gender and low socio-economic status. In Switzerland, as in most industrialized European countries, the prevalence of inactivity is alarming and increases over time.

The Swiss Household Panel (SHP), a longitudinal national survey offers a representative data base including social determinants of inactivity. In 1999, 7799 members of 5074 households answered a personal computer assisted telephone interview (CATI). The original sample is followed yearly until today. Three waves (1999 to 2001) are presented here (N=5426). Inactivity was defined as getting slightly out of breath. The prevalence and incidence of inactivity is reported cross-sectionally and longitudinally selected social determinants were included as risk factors for inactivity: demographic characteristics (age, gender, linguistic region, nationality), activities of daily living (ADL) limitation, socio-economic status (professional, income, education), employment status, working hours, and leisure activities. The SAS GENMOD procedure was used to estimate the risk of inactivity (OR, 95% CI) over time using social determinants as predictors.

The prevalence of inactivity increased slightly from 1999 to 2001, from 34.8%, 37.8% to 38% respectively. Overall 15% became inactive in 2000 and 14% in 2001. Women are more prone to modify their activity level. Significant determinants of inactivity are: increasing age, Italian and French speaking regions compared to German Swiss, low social level, low leisure satisfaction, and TV watching. For women, increasing working hours and number of children are associated with inactivity. Women not walking and men not engaging in do it yourself activities are less active. ADL limitation and reading do not predict inactivity.

The slight net increase in inactivity every year masks the more important individual spontaneous fluctuation over time. Social characteristics are influencing physical activity and are gender specific. Inactivity in women is determined by the number children and the working hours. Health enhancing physical activity programs (HEPA) should be targeted accordingly. Researchers should consider spontaneous changes in physical activity when evaluating preventive programs.

## Oral Session

### Biomechanics 1

O1011

#### O1011-1

#### Influence of the knee joint initial position on intra-individual variability in squat jumping

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*Keywords: biomechanics, variability*

The goal of the present study was to examine the effects of various starting positions of the knee joint on the amount of intra-individual variability in squat jumping performance.

For this purpose, six regional to national male volleyball players were filmed while performing 10 maximal squat jumps on a force plate at three different and randomised initial positions of the knee joint, i.e. 80°, 100° and 120° with 180° corresponding to the maximal knee extension. The hip initial position was chosen according to the subjects' preferred angle. To avoid fatigue effects, a 3-minute rest interval was imposed between the jumps. In order to compare the mean and standard deviation values of all the studied parameters between the three jump conditions, the Friedman and Wilcoxon tests were successively used.

Results revealed that the vertical ground reaction force pattern differed between the three jump conditions. The impulse phase duration and the time to reach peak force were significantly shorter in the 120° than in the 100° and the 80° ( $p < .05$ ). The amount of intra-individual variability of these two parameters was not different between conditions. The jump height was significantly greater in the 80° condition than in the 100° and the 120° conditions ( $p < .05$ ) (Fig. 2). The lowest Hmax was attained in the 120° jumps ( $p < .05$ ). Concerning intra-individual variability, the 120° condition causes a greater variability in jump height than 100° and 80° ( $p < .05$ ).

These findings pointed out that the jumping performance was inversely related to the initial knee extension. Thus, it seems that the knee extensors need to shorten over the largest length range in order to maximise their work. The timing of force application does not seem to be variable under different joint initial positions. From these results, it can be hypothesized that the variability could be mainly caused by changes in inter-joint coordination patterns. Especially, the greater variability of jump height found in the 120° condition tends to show that the hip joint initial position could be determinant in stabilizing the jump execution.

#### O1011-2

#### Force production and activation level during contractions performed at different velocities in aged and young subjects

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*Keywords: force production, neural activation, aging*

This work was designed to discuss the mechanisms underlying the loss of force during different contraction modalities with ageing.

The experiments were carried out on 10 young (20-30 yr) and 10 elderly subjects (70-85 yr). Torque and EMG activity during maximal voluntary contraction (MVC) of the ankle dorsiflexors and in response to a supramaximal electrical stimulus (M-wave and corresponding mechanical twitch) were recorded in isometric (ISO) condition, with the ankle positioned at an angle of 90° (neutral position). Torque and EMG activity were also recorded during maximal concentric (CON) and eccentric (ECC) contractions at different angular velocities (5°/s, 25°/s, 50°/s, 75°/s and 100°/s). The level of muscle activation was assessed by the interpolated-twitch (IT) method and by the normalisation of voluntary EMG to the M-wave.

Our results showed that, compared with younger, older subjects had a mean torque deficit of 23% ( $P < 0.05$ ) and 38% ( $P < 0.01$ ), respectively in ISO and in CON contractions. A small (10%) but non significant difference in torque was observed during ECC contractions between the two groups. The IT method indicated that the subjects were able to activate maximally their dorsiflexors, since the superimposed electrical stimuli did not induce any force increment. In contrast, during ECC contractions at high velocities, submaximal activation was observed in some trials, but in the same proportion for young and old subjects. This viewpoint is also supported by the finding of a similar ratio between voluntary EMG and M-wave in young and aged subjects, for the different modalities of contraction. In contrast, the time course of the mechanical twitch was prolonged in elderly subjects compared to younger ones.

Our results suggest that the decline in torque with ageing is mainly the result of peripheral changes. The observation of a slowing of the twitch time course supports the viewpoint that the excitation-contraction coupling is slowed down with ageing. Our finding of a smaller torque loss during ECC contraction in elderly subjects, compared with CON contractions, could be explained by increased connective tissue (Winegard et al, 1996) and/or slowing of cross-bridges cycling (Porter et al, 1995).

Porter MM et al. (1995). *Can J Physiol*, 20: 429-439

Winegard KJ et al. (1996). *J Gerontol*, 51A: B202-207

## O101I-3

**Influence of pedaling rate on neuromuscular and mechanical patterns during endurance cycling**

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*Keywords: pedalling, pattern, cadence*

The purpose of this study was to assess the influence of the pedaling rate on neuromuscular and mechanical parameters during a prolonged cycling exercise.

Eleven well-trained subjects performed three one-hour pedaling sessions at three different cadences (50, 110 RPM and the freely chosen cadence), at an intensity corresponding to 65% of their maximal aerobic power output. Neuromuscular activities of the vastus lateralis (VL), rectus femoris (RF), gastrocnemius lateralis (GL) and biceps femoris (BF) muscles were studied quantitatively (RMS) and qualitatively (activation and deactivation patterns). The mechanical pattern during pedaling was assessed through peak torque angle, positive work and negative work. One-way ANOVAs and repeated measures ANOVAs were conducted to analyze cadence and time effects on tested parameters respectively.

Neuromuscular activities of all muscles were influenced by cadence. EMG response to cadence manipulations differed widely between muscles. A significant increase was noted in neuromuscular activity of the VL and RF muscles at 110 RPM at the end of the pedaling session, whereas a decrease in neuromuscular activity of the BF muscle occurred after one hour of pedaling at 50 RPM. EMG bursts onset and offset patterns shifted earlier in the crank cycle as cadence increased. Positive and negative work increased with cadence. Additionally, the peak torque angle shifted later in the crank cycle as cadence increased. No time effect was found neither on the neuromuscular pattern nor on the mechanical pattern.

The various functional roles of the tested muscles may explain their different responses as cadence is modified. EMG drift may traduce higher muscular constraints as exercise progresses at higher cadence. A decrease in EMG activity of the BF muscle appeared to be an acute adaptation in order to prevent excessive muscle tension in the knee extensors. An increase in negative work as cadence increases may oblige positive work to overcome, what may explain the increase in the neuromuscular activity of VL and RF as exercise progresses. Earlier muscle bursting seemed to be a mechanism preventing too late muscular force development during the crank cycle as cadence increased, due to electromechanical delay, but seems insufficient to overcome the later peak torque occurrence in the crank cycle when the pedaling rate increases. The present results suggest that neuromuscular and mechanical patterns are determined by the chosen cadence, but are not altered by fatigue during a one-hour middle-intensity cycling bout.

## O101I-4

**Mechanical factors of sprint cycling performance measured by torque-velocity test in top-level track cyclists**

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*Keywords: cycling, elite athletes, torque-velocity relationship*

In sprint track cycling, the 200 m flying start is the most explosive event. Yet, mechanical pedalling characteristics may be thoroughly measured on cycle ergometer from the torque-velocity test (Arsac, 1996). The purpose of this study was to examine how performance in 200 m flying start could be related to anthropometrics and muscular mechanical factors in a group of world-class track cyclists.

Twelve male sprinters (world-class level, age (mean  $\pm$  SD)  $24.3 \pm 3.9$  years, height  $181 \pm 4$  cm, body mass  $82.5 \pm 5.2$  kg and total leg volume  $11.11 \pm 1.1$  l) volunteered to perform three 5-s sprints on a cycle ergometer. Individual torque- and power-velocity relationships were drawn in order to identify maximal torque (Tmax in N.m), maximal cycling rate (Vmax in rpm), maximal power (Pmax in W and W.kg<sup>-1</sup>) and the corresponding optimal cycling rate (Vopt in rpm). Characteristics of the best 200 m performances included in this study were the mean speed (V200rec in m.s<sup>-1</sup>) and cycling rate (Fr200rec in rpm).

Pmax (1586 W) is significantly correlated with Tmax (233.9 N.m,  $P < 0.001$ ). Tmax is significantly correlated with total leg volume ( $P < 0.05$ ). Concerning the 200 m performance, V200rec (19.19 m.s<sup>-1</sup>) is strongly related to Fr200rec (155.1 rpm,  $P < 0.001$ ). Vopt (129 rpm) was the muscular mechanical factor the most tightly related with V200rec ( $P < 0.01$ ). Finally, Fr200rec remains significantly higher than Vopt, by almost 20% ( $P < 0.001$ ).

The relationship between V200 and Fr200 is due to the fact that only three very close gear ratios were usually employed. The main feature is the significant relationship observed between V200 and Vopt. In accordance with Hautier et al (1996) who suggest Vopt to be related to the percentage of fast twitch muscle fibres, having a higher Vopt must be a benefit. This might also be attributed to the fact that sprinters with higher Vopt (but with almost the same Fr200rec) must be closer to this optimal cycling condition for power production during the track sprint.

Concerning the unexpected lack of relationship between V200rec and Pmax, it could be assumed that cyclists should produce their Pmax during the acceleration phase (before the start line) and maintain a slightly lower mean power during the 200 m. The influence of differences in individual parameters like drag coefficient and frontal area and the justification of the choice of gear ratios that not allow them to be in Vopt condition remains to be investigated.

Arsac et al (1996) *Eur J Appl Physiol* 74:100-106

Hautier (1996) *Eur J Appl Physiol* 74 :114-118

O101I-5

**Estimation of passive drag and the projected frontal surface area of swimmers with disabilities****Kunze Katrin, Schega Lutz**

Institute of Sport Rehabilitation, Sport Therapy and Adapted Physical Activity, Germany

*Keywords: sport for disabled, classification in swimming, passive drag in water*

Over the last years there is a rising interest in questions which are relevant for persons with disabilities. For the organisation of competitions between persons with impairment the type and degree of functional impairment is estimated by medical diagnostic and a swimming demonstration (classification). The swimmers are divided into diverse functional classes (FC). To improve the objectivity in assessment, two additional parameters were investigated, the passive drag in water (FPD in N) and the projected frontal surface area (FSA in cm<sup>2</sup>) during a pull try with the "Portable Swimmerspecific Test- and Trainingsdevice (PSTT)". The influence of both values on the FC are investigated and discussed.

With the "PSTT" (Schega et al. 2002) and a camera placed under water 103 athletes with physical disabilities were investigated. The pull try was carried out in a standard body position and with a standard velocity of  $v_S = 1,0$  m/s. The parameters FPD and FSA were measured. From the force curve an average over the plateau was estimated. The circumferences of the camera picture were determined and the included area was calculated (FSA). Further the averages of forces and the FSA were summarized for each FC. The relationship between the FPD and FC were graphed and the correlation by PEARSON was estimated also for FSA and FC.

The linear regression showed a negative correlation coefficient for both, the relationship between FPD and FC ( $r = -0.95$ ) and between FSA and FC ( $r = -0.85$ ). That means, with increasing functional class (sinking degree of impairment) both the FPD and the FSA are decreasing.

With increasing functional class, the formation of "unfavourable" areas of drag in water, caused by the disability, decreases. The parameters FPD and FSA showed a comparable behaviour. This could be proved with this study. Therefore both criterions could be used to improve the objectivity in assessment of the functional abilities of disabled swimmers.

*Doll-Tepper G (1998). International perspectives on research in adapted physical activity.*

*Sherill C (1999): Disability Sport and Classification Theory: A New Era. Adapted physical activity quarterly, Vol. 16: 206-215*

*Schega L et al (2002). Portables Schwimmerspezifisches Test- und Trainingsgerät*

O101I-6

**Consistency of rowing technique in the mid-race phase of 2000m rowing races****Mattes Klaus, Draper Constanze**

Humboldt University of Berlin, Germany

*Keywords: rowing, technique*

The consistency of the rowing technique often determines the result of a rowing race. In a race, approximately 220-250 strokes must be applied under changing external and internal conditions. Until now, many biomechanical tests focused on the analysis of technique for an averaged single stroke, without an explicit inclusion of its consistency during the duration of the rowing effort.

Four Junior and one Senior Men's Eights (including international medal winners) were examined. The boats were set up with a mobile testing system, which collected continuously the parameters of oar angle, handle force, boat acceleration and boat velocity. The test of the Senior Men's Eight took place during an international regatta in Ratzeburg in 1998. 134 strokes were evaluated from the mid-race phase - the duration between the start and finish phases (ca. 70 to 340sec). During this phase, the smallest changes in the stroke rate occur.

The rower-specific parameters (stroke length (+/-1.5%), catch angle (+/-3.5%), and finish angle +/-0.5%) show a high consistency in all subjects. The mean handle forces during the drive phase +/-6%), handle force-time and handle force-oar angle trace, show a lack of consistency. The higher the standard of rowers, the greater the consistency of their technique. This is shown by the decreasing standard deviation values and less variability in the parameter time series. Although external conditions (stroke rate, rhythm) were similar for crew members of the Men's Eight, internal differences between individuals were still observable. These inter-individual differences in technique consistency were visible in the spatial, spatial-temporal and dynamic characteristics and in the individuals established technique patterns.

The consistency of the rowing technique is a unique descriptor of technical ability needing more attention in rowing diagnostics. It is characterised by the relationship of technical skills, fitness level, duration of effort and environmental conditions. The technique consistency can be described quantitatively through the standard deviation of biomechanical parameters and time series, thus providing a more comprehensive analysis of the rowing technique.



## Oral Session

## Physiology 1

O101J

## O101J-1

**Myotoxic and hypertrophic effects of a low dose of clenbuterol****Burniston Jatin, Tan Lip-Bun, Clark William, Goldspink David**

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*Keywords: apoptosis, necrosis, anabolic agent*

We have chosen two relatively safe doses of clenbuterol and investigated the myotoxic effects of repeated administrations in a rodent model.

Male Wistar rats were given bi-daily subcutaneously injections of either 1 ug.kg<sup>-1</sup> or 10 ug.kg<sup>-1</sup> of clenbuterol or the saline vehicle only, for a period of 32 days. At specific time points (0, 8, 16 and 32 days), animals (control and clenbuterol treated) were killed and the incidence of apoptotic and necrotic cell death in the heart, diaphragm, soleus, tibialis anterior and gastrocnemius investigated.

No apoptotic or necrotic cell death was found in the heart, diaphragm, tibialis anterior or gastrocnemius in response to any of the interventions. In the soleus muscle, a small basal level ( $0.042 \pm 0.03\%$ ; mean  $\pm$  SEM) of apoptosis was evident in both the 1 ug.kg<sup>-1</sup> clenbuterol and control groups. Following a single administration of 10 ug.kg<sup>-1</sup> clenbuterol, a significant ( $P < 0.05$ ) amount of both apoptotic ( $5.83 \pm 2.1\%$ ) and necrotic ( $3.79 \pm 0.5\%$ ) cell death was evident in the soleus. The incidence of which, diminished with repeated administrations, had returned to control values by day 32. Body weights and tissue wet weights (heart, soleus, tibialis anterior and gastrocnemius) significantly ( $P < 0.05$ ) increased from day zero to day 32. Following 32 days of intervention, only the heart mass of those animals which had received bi-daily injections of 10 ug.kg<sup>-1</sup> clenbuterol had significantly ( $P = 0.012$ ) increased (11%), no other significant effects were found. These data demonstrate that the myotoxic effects of a low dose of clenbuterol are restricted to the soleus muscle only. Furthermore, the incidence of damage in the soleus muscle diminishes with repeated administrations. In light of our previous findings that clenbuterol-induced cell death is mediated through the beta2-adrenergic receptor, it may be that this reduction in myotoxicity is due to receptor desensitisation.

We conclude that higher doses or more regular administrations, of the doses used in the current study, may be used to investigate the hypertrophic effects of clenbuterol with a view to possible therapeutic interventions.

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## O101J-2

**Effects of acute growth hormone administration on fat mobilisation and substrate utilization during moderate intensity bicycling****Hansen Mette, Morthorst Rikke, Wiborg Lange Kai Henrik, Larsson Benny, Flyvbjerg Allan, Ørskov Hans, Astrup Arne, Kjær Michael**

Bispebjerg Hospital, Denmark

*Keywords: exercise, growth hormone, fat metabolism*

The effects of acute Growth Hormone (GH) administration on metabolism during subsequent exercise are not studied thoroughly. We studied the effects of GH administration on fat metabolism during rest and cycling in a randomised, double-blinded, crossover design.

Seven highly trained men (age:  $25 \pm 5$  yr (mean  $\pm$  SD),  $\text{VO}_2\text{peak}$ :  $62 \pm 3$  ml/min/kg) performed 4 trials; (trial 1 and 2) 120 min bicycling (EX) at 55%  $\text{VO}_2\text{peak}$  4 h after receiving 7.5 IU (2.5 mg) GH or placebo (plc) and (trial 3 and 4) no exercise after receiving the same dose of GH or Plc. In all studies a standardized meal was given 2h after the GH/plc injection.

GH-administration resulted in significant increases in the concentration in s-GH both in the resting studies (time \* treatment:  $p < 0.0001$ ; treatment:  $p < 0.0001$ ) and at the exercise study days (time \* treatment:  $p < 0.0001$ ; treatment:  $p < 0.0001$ ). The effect of exercise on the s-GH were additive. The increases in s-GH were followed by an increase in circulating glycerol in the resting studies (time \* treatment:  $p < 0.0001$ ; treatment:  $p < 0.0001$ ). When combined with exercise the increase in glycerol was very pronounced (GH: 716% vs. Plc: 328%,  $p < 0.0001$ ). The same pattern was seen for s-NEFA. However, this increase in fat mobilisation did not result in a detectable increase in whole body fat utilization (indirect calorimetry). Furthermore, GH-administration combined with EX resulted in a small, but significant increase in circulating lactate (time \* treatment:  $p = 0.07$ ; treatment:  $p < 0.0001$ ). In addition, plasma glucose concentration was significantly higher (4%) after GH administration during the EX trial (treatment:  $p < 0.0013$ ).

We conclude that a single GH-dose had an exaggerated lipolytic effect both at rest and during exercise in humans. Despite the higher fatty acid availability after GH-injection, whole body substrate utilization during exercise did not change significantly.

## O101J-3

**Little effect of induced metabolic alkalosis during training, on adaptations in muscle buffer capacity****Edge Johann, Bishop David, Goodman Carmel**

The University of Western Australia, Australia

*Keywords: interval training, hydrogen ions*

The purpose of this study was to induce metabolic alkalosis during training, so as to investigate the role of hydrogen ion accumulation in stimulating changes in muscle buffer capacity.

Sixteen active, but not well-trained females (mean  $\pm$  SD: age 20  $\pm$  3 y, mass 62.3  $\pm$  10 kg, peak VO<sub>2</sub> 2.30  $\pm$  .39 L·min<sup>-1</sup>) participated in this study. Tests consisted of a graded exercise test followed ~48 h later by an endurance test (ET; total work at peak VO<sub>2</sub> intensity). After initial testing the subjects were randomly assigned to one of two training groups. One group ingested sodium bicarbonate (NaHCO<sub>3</sub>, 0.4 g·kg<sup>-1</sup>) while the control group ingested a placebo (NaCl, 0.2 g·kg<sup>-1</sup>) prior to each training session. Each subject had a matched partner (matched on LT and ET) in the opposing group, with whom they completed an equal amount of work during training. Training involved high-intensity intervals (2 min: 1 min rest), performed three times per week, for eight weeks.

There were significant increases in total work completed during the ET (160% NaHCO<sub>3</sub> v 126% control;  $p < 0.05$ ) after training, with no significant differences between groups ( $p > 0.05$ ). Both groups also had significant improvements in muscle buffer capacity, peak VO<sub>2</sub> (22% NaHCO<sub>3</sub> v 17% NaCl;  $p < 0.05$ ) and LT (26% NaHCO<sub>3</sub> v 15% NaCl;  $p < 0.05$ ), with no significant differences between groups. Training did not result in any significant changes in [PCr], [La]<sup>-</sup>, [La]<sup>-</sup>b, [H<sup>+</sup>], [H<sup>+</sup>]<sup>b</sup> or anaerobic yield of ATP (pre or post ET) for either group ( $p > 0.05$ ).

These results support previous findings, that high-intensity interval training can significantly improve muscle buffer capacity. We have also shown that ingesting NaHCO<sub>3</sub> and therefore altering the likely accumulation of H<sup>+</sup> during training, did not affect these adaptations. There were large improvements in endurance performance by both groups (NaHCO<sub>3</sub> 160% v control 126%), after the training period. This may have been the result of the intense nature of the training regimen and/or the prior fitness level of the subjects. Our findings also indicate that high-intensity interval training resulted in enhanced aerobic metabolism rather than anaerobic metabolism during the ET.

#### O101J-4

### Changes in serum immunoglobulins and eosinophil cationic protein following an ultra-marathon

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**Keywords:** exercise immunology, immunoglobulin, eosinophil

Ultra-endurance exercise is associated with tissue damage and local inflammation. It has been hypothesized that this damage results in a T-helper 2 response with subsequent up-regulation of humoral immunity. This suggests that immunoglobulins, as well as other humoral immune responses, may be altered after ultra-endurance exercise. The purpose of this study was to determine changes in plasma immunoglobulins and a marker of eosinophil activation, eosinophil cationic protein (ECP) in 11 experienced volunteers (6 males, 5 females, age 43  $\pm$  9.8 years), 24 h prior to projected finishing time, immediately after (IPE), 3 h, 24 h, and 72 h after an ultra-marathon (90 km).

Venipunctures were performed and serum was stored at 80°C until analysis. IgM, IgD, IgA, IgG and IgG1, 2, 3 and 4 were measured by light scatter using laser nephelometry, IgE was measured using the Alastat Microplate Total IgE kit and ECP using fluo-enzyme immunoassay. Data was analysed using an ANOVA comparing values to pre-exercise levels.

The following immunoglobulins were significantly altered when compared to pre-race values ( $p < 0.05$ ): IgD, IPE (-51%)

and 24 h (-41%); IgM at 24 h (-20%) were significantly decreased. Total IgG (+12%) and IgG1 (+11%) were significantly elevated IPE, whilst ECP was significantly elevated at 72 h (+52%). The following immunoglobulins and isotypes showed no change: IgG2, IgG3, IgG4, IgA, and IgE. In experienced ultra-endurance runners, the changes in post-race immunoglobulin concentration suggest isotype switching by T-helper 2 cells. The presence of ECP suggests the activation of eosinophils, which is also indicative of a T-helper 2 response. This was a surprising finding as eosinophil activation is normally under tight control to prevent inappropriate toxic responses, which could lead to further tissue injury.

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#### O101J-5

### The effect of glucose infusion on 1h cycle time-trial performance

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**Keywords:** performance, carbohydrate, metabolism

Numerous studies have reported a beneficial effect of exogenous carbohydrate during exercise lasting approximately 1h despite the fact that endogenous carbohydrate is not thought limiting for exercise of this duration.

We have investigated whether by-passing the mouth and gut by infusing glucose would yield the same benefits in performance as reported for oral supplementation. Glucose kinetics were monitored using stable isotopes and we hypothesised that glucose infusion would increase glucose uptake and oxidation by muscle but would not affect performance.

Eight endurance cyclists (VO<sub>2peak</sub> = 60.0  $\pm$  1.6 (mean  $\pm$  SE) ml/kgbw/min) completed two performance trials in which they had to accomplish a set amount of work as quickly as possible (924  $\pm$  54kJ). On one occasion a glucose solution (20% in saline; CHO) was infused to deliver glucose at a rate of 1g/min. On the other occasion a saline solution (PLA) was infused. A primed continuous infusion of [6,6-<sup>2</sup>H<sub>2</sub>]-glucose was used on both occasions (n=5) to measure the rate of appearance (Ra) and disappearance (Rd) of glucose. Measurements of <sup>13</sup>C enrichment in expired CO<sub>2</sub> allowed measurement of exogenous carbohydrate oxidation (Rox). Rd measurements are only reported for the last 15min of the exercise.

There was no difference in performance time between CHO and PLA (61.20  $\pm$  1.82min, CHO, vs. 61.37  $\pm$  1.90, PLA, respectively).

Plasma glucose concentration increased from 4.9  $\pm$  0.1mmol/L at rest to 12.6  $\pm$  0.9mmol/L during the CHO trial and from 4.8  $\pm$  0.1mmol/L to 6.2  $\pm$  0.4mmol/L during the PLA trial. These values were significantly higher at all time-points during exercise in the CHO trial compared to PLA ( $p < 0.001$ ). Glucose infusion markedly increased the Ra and Rd of plasma glucose. In the final stages of the time-trial, Rd in the CHO trial was 91.2  $\pm$  8.2μmol/kg/min compared to 48.2  $\pm$  5.8μmol/kg/min in the PLA trial ( $p = 0.016$ ). Rox was at least 27.0  $\pm$  3.4g and contributed 14% to total CHO oxidation in the

CHO trial. Total carbohydrate oxidation did not differ between CHO and PLA trials ( $3.5 \pm 0.3\text{g/min}$  and  $3.4 \pm 0.3\text{g/min}$  respectively).

The results demonstrate that glucose infusion had no effect on 1h cycle time-trial performance despite an increased availability of plasma glucose for oxidation and evidence of increased glucose uptake into tissues.

These results suggest that the reported improvements in performance with carbohydrate feeding are most likely a central effect mediated by glucoreceptors in the mouth or gut. The role of glucoreceptors during exercise warrants further investigation.

#### O101J-6

### Ventilatory limitation on prolonged exercise at high altitude

**Flatz Markus, Faulhaber Martin, Burtcher Martin**

Institute of Sport Science, University of Innsbruck, Austria

*Keywords: exercise, ventilatory limitation, high altitude*

There are no investigations dealing with changes of breathing reserve or with possible ventilatory limitation during prolonged exercise at high altitude.

We studied five men prior to, during and after a 50min exhausting constant load cycle exercise at 600m (LA) on the first (HA1) and the third day (HA3) at 3200m. We observed forced vital capacity (FVC), forced expiratory volume in the first second (FEV1), maximal voluntary ventilation (MVV) and minute ventilation (VE), tidal volume (TV), respiratory rate (RR) and oxygen consumption (VO<sub>2</sub>) during exercise. Breathing reserve (BR) was calculated as difference of MVV and VE in per cent. In addition, we measured arterial oxygen saturation (SaO<sub>2</sub>), heart rate (HR) and power output (P) during work. For statistical analyses paired student t-test ( $p < 0.05$ ) and Pearson correlations were used.

Compared to LA, ventilation increased at HA3 ( $103.8 \pm 17.3$  l/min vs.  $139.3 \pm 16.0$  l/min,  $p < 0.05$ ). MVV decreased at HA1 ( $218.6 \pm 18.2$  l/min vs.  $193.1 \pm 8.0$  l/min,  $p < 0.05$ ) and at HA3 ( $218.6 \pm 20.9$  l/min vs.  $195.0 \pm 19.9$  l/min,  $p < 0.05$ ). Therefore BR decreased at HA1 and HA3 compared to LA ( $34.3 \pm 12.8\%$  and  $28.6 \pm 3.0\%$  vs.  $52.7 \pm 5.1\%$ ,  $p < 0.05$ ). SaO<sub>2</sub> decreased compared to LA, at HA1 ( $94.2 \pm 1.1\%$  vs.  $81.2 \pm 3.3\%$ ,  $p < 0.001$ ) and at HA3 ( $94.2 \pm 1.1\%$  vs.  $82.8 \pm 1.1\%$ ,  $p < 0.001$ ). HR decreased from LA to HA3 ( $174.4 \pm 7.0$  bpm vs.  $167.8 \pm 6.6$  bpm,  $p < 0.05$ ). P increased from HA1 to HA3 ( $163.0 \pm 25.6$  W vs.  $171.4 \pm 30.8$  W,  $p < 0.05$ ).

The relative high BR at HA1 and at HA3 should be interpreted carefully as "enough BR" since all subjects' complained of hard respiratory work during the 50min exercise, especially at HA1. Anyway, the trend that BR decreased further on the third day (HA3) indicates the possibility of a central rather than a mechanical limitation of breathing. The increased P at HA3 also points to this speculation. Otherwise the acute exposition to dry, hypoxic air provokes bronchospasm and limits the required dilatation of the bronchi. Thus, we speculate that the hypoxic bronchoconstriction and the stimulus of the mucous membrane of the bronchial tube due to dry air are responsible for the decrease of MVV at high altitude. Although the methodology to detect ventilatory limitation is controversial these data indicate a considerable ventilatory limitation during prolonged exercise at high altitude. It is still unclear if central or mechanical mechanisms are responsible.

## Symposium

## The Molecular Adaptation to Aerobic Exercise

S102A

## S102A-1

**Overview of the adaptive responses of skeletal muscle to endurance exercise****Holloszy John**

Washington University School of Medicine, United States

*Keywords: exercise, muscle, mitochondria*

Endurance exercise induces an increase in mitochondria in skeletal muscle. This adaptation results in increases in the capacity of muscle to oxidize pyruvate, fatty acids, and ketones, and to generate ATP via oxidation phosphorylation. It also involves the non-mitochondrial protein GLUT4, which mediates insulin- and exercise-stimulated glucose transport into muscle. The increase in mitochondrial enzymes is mediated by increased protein synthesis, with no change in degradation rate. As a consequence of this adaptation, there is less disturbance of intracellular homeostasis, with decreased glycogen utilization, reduced lactate production and increased fat oxidation in muscle at the same work rate. The transcription factors NRF-1 and NRF-2 activate nuclear genes that encode a number of mitochondrial respiratory chain proteins as well as delta-aminolevulinic synthase which limits the rate of heme synthesis, and mitochondrial transcription factor A, which activates mitochondrial DNA transcription and replication. The transcription factor PPARalpha regulates the nuclear genes that encode the enzymes of the mitochondrial fatty acid oxidation pathway, while transcription factors of the MEF2 family regulate expression of GLUT4. Discovery of the transcriptional coactivator PGC-1alpha provided new insights regarding how the signals generated by adaptive stimuli result in a coordinated response of the transcription factors responsible for mitochondrial biogenesis. PGC-1alpha coactivates NRF-1, PPARalpha and MEF2s and also induces increased expression of NRF-1 and NRF-2. Overexpression of PGC-1 in cultured myocytes or in heart muscle of transgenic mice greatly stimulates mitochondrial biogenesis.

Recent studies showed that a bout of exercise induces increases in PGC-1alpha, NRF-1, NRF-2 and mtTFA in skeletal muscle. Like exercise, intermittently raising cytosolic Ca<sup>2+</sup> in L6 myotubes for 5 hr/day by exposing them to caffeine or W7, which release Ca<sup>2+</sup> from the sarcoplasmic reticulum, or to the Ca<sup>2+</sup> ionophore ionomycin, for 5 days induces an increase in mitochondria. The increase in mitochondria induced by raising cytosolic Ca<sup>2+</sup> is prevented by the CAMK inhibitor KN93, providing evidence that the adaptive response is mediated by CAMK activation. The adaptive response induced by raising cytosolic Ca<sup>2+</sup> and activation of CAMKs in L6 myotubes further mimics that induced in skeletal muscle by exercise in that it also involves induction of increases in PGC-1alpha, mtTFA, NRF-1 and NRF-2.

## S102A-2

**Transcriptional activators and coactivators in the regulation of mitochondrial biogenesis****Baer Keith**

University of Michigan, United States

*Keywords: mitochondrial biogenesis, PGC-1, transcription*

Endurance exercise training induces an increase in the respiratory capacity of muscle due largely to a coordinated genetic response that increases the capacity to generate ATP and the efficiency of muscle contraction. This genetic program increases mitochondrial proteins, the exercise- and insulin-stimulated glucose transporter Glut4, and shifts the contractile and regulatory proteins to a more efficient state. Over the last few years, the precise mechanism coupling an increase in metabolic demand with this coordinated change in muscle phenotype has largely been elucidated. Work from a number of labs has elegantly shown how increasing metabolic demand or intracellular calcium leads to the activation of a transcriptional coactivator called the peroxisome proliferator-activated receptor gamma coactivator-1 (PGC-1). PGC-1 is the master regulator of the endurance phenotype. However, PGC-1 has no known direct effects on the transcription of mitochondrial or contractile genes. All of the effects of PGC-1 are mediated indirectly through a series of transcriptional partners. The activators that transduce the PGC-1 signal such as NRF-1, PPARalpha and MEF-2 bind to the promoters of genes induced by endurance exercise, and with PGC-1 activate their transcription. This model of simultaneous coactivation by one master regulator is not only important in determining the phenotype of muscle but is biologically conserved in other tissues as well.

## S102A-3

**Role of calcium and AMPK in the regulation of mitochondrial biogenesis and GLUT4 levels in muscle****Ojuka Edward, Holloszy John**

University of Cape Town, South Africa

*Keywords: mitochondrial biogenesis, CaMK, AMPK*

Endurance exercise training induces increases in the levels of mitochondria and GLUT4 in skeletal muscles. In our current study we present evidence that AMPK, Ca<sup>2+</sup> and a Ca<sup>2+</sup>-calmodulin-activated protein kinase (CaMK) are involved in these adaptations.

We exposed L6 myotubes to agents that alter cytosolic Ca<sup>2+</sup> levels and to AICAR, which activates AMP kinase, for 2-5 days and measured changes in GLUT4, mitochondrial proteins, and transcription factors. The capacities for pyruvate and oleic acid oxidation and 2-deoxyglucose transport were also determined.

Caffeine, an agent that releases Ca<sup>2+</sup> from the sarcoplasmic reticulum (SR), caused ~ fourfold increase in cytosolic Ca<sup>2+</sup> levels above basal, and dantrolene, a SR Ca<sup>2+</sup> channel blocker, attenuated this increase. The Ca<sup>2+</sup> ionophore, ionomycin, caused a marked but transient increase in cytosolic Ca<sup>2+</sup> levels. EGTA, a Ca<sup>2+</sup> binding agent,

abolished the effect of ionomycin. After 5 days of treatment with caffeine or ionomycin, both nucleus-encoded and mitochondrial-encoded proteins were increased 50-150%. Dantrolene or EGTA partially abolished the increases due to caffeine or ionomycin respectively. GLUT4, MEF2A, and insulin stimulated 2-deoxyglucose transport were increased 80 - 90% after 5 days of incubation with caffeine, compared to controls. The CAMK inhibitor, KN93, completely blocked the increases in GLUT4 and mitochondrial enzymes caused by caffeine. Pyruvate and oleic acid oxidation in the presence of non-limiting concentration of ADP and Pi were both increased by about 60% after 5-day treatment with caffeine. AICAR also induced increases in GLUT4, MEF 2A, COX1 and cytochrome c.

These studies provide insights for an understanding of the mechanism responsible for the adaptations observed in muscle in response to endurance training. We found that an increase in cytosolic Ca<sup>2+</sup> induces mitochondrial biogenesis and increases oxidative capacity and glucose transport capacity in myotubes in culture. We provide evidence in support of the hypothesis that activation of a CaMK is involved in regulating the levels of GLUT4 and mitochondrial enzymes. To more directly study the involvement of CaMK in biogenesis we constructed a CaMK IV adenoviral expression system. Preliminary results indicate that over-expression of a constitutively active form of CaMK IV up-regulates the levels of ALAS, Cytochrome c and citrate synthase.

#### S102A-4

### The molecular assembly of mitochondria

Hood David, Joseph Anna-Maria

York University, Canada

*Keywords: exercise, muscle, mitochondria*

Regular physical activity in the form of endurance training produces a well-established adaptation in skeletal muscle termed mitochondrial biogenesis. Mitochondrial biogenesis is a product of complex interactions between the nuclear and mitochondrial genomes. Signaling pathways activated by exercise initiate the activation of transcription factors which increase the production of mRNA from nuclear and mitochondrial DNA. Nuclear gene products are synthesized in the cytosol as precursor proteins with targeting signals. These precursor proteins combine with molecular chaperones which direct them to the import machinery of the mitochondrial outer membrane (Tom complex). The precursor is unfolded and transferred through the outer membrane, across the intermembrane space to the mitochondrial inner membrane translocases termed the Tim complex. mtHSP70 pulls the precursor into the matrix space, mitochondrial processing peptidase cleaves off the targeting sequence, and HSP60 and Cpn10 combine to refold the protein into its mature conformation. Muscle contractile activity accelerates protein import into the mitochondria. It does this by stimulating an increased expression of some of the components of the import machinery. This is important for the overall expansion of the mitochondrial reticulum, and the physiological benefit of this is an improved endurance performance. Conversely, impairments in the import process can be a cause of mitochondrial dysfunction and disease. Efforts are underway to further characterize the functions of the import machinery components and to examine the effect of contractile activity on protein import in a variety of mitochondrial diseases.

## Oral Session

### Physiology 2

O102B

#### O102B-1

### Force and surface mechanomyogram relationship during fatiguing stimulation in human quadriceps femoris

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*Keywords: muscle fatigue, functional electrical stimulation, mechanomyogram*

The changes of the contractile properties of the muscle with fatigue can be tracked by the peak force of single twitch (Fp). When supramaximally stimulated, muscle behaves as "a large artificial motor unit" and its contraction is coupled with dimensional changes of its transverse diameter that can be detected by means of an accelerometer: the resulting electrical signal has been labelled as surface mechanomyogram (MMG). Because of fatigue, both Fp and MMG peak-to-peak (MMG-pp) decrease. The aim of this study was to verify the reliability of the MMG as a tool to investigate the mechanical fatigue phenomenon by means of Fp and MMG-pp compared analysis during single twitches obtained by the use of stimulation protocols usually employed for sport training and rehabilitation programs.

For this purpose, 10 healthy sedentary subjects were seated on an anatomical ergometer with the right knee fixed at 90°. Force produced by the vastus lateralis (VL) during stimulated contractions has been recorded by a load cell. MMG and electromyogram (EMG) were detected proximally from the VL distal motor point where a monopolar supramaximal stimulation was delivered according to the following protocol: 1) potentiation phase: 24 cycles (each presenting six 100 Hz pulses, 1 s pause, 1 single twitch and 4 s rest) with the aim to allow the muscle to reach the optimal "active state"; 2) fatiguing phase: 50 cycles, each of them presenting several periods: 2 s at 50 Hz, 12.5 s at 2 Hz, six 100 Hz doublets with 0.5 s between each doublet, 12.5 s at 2 Hz.

Averaged normalised values of Fp and MMG-pp both decreased from their initial 100% values to 40% during 2 Hz stimulation while to 50% (Fp) and 60% (MMG-pp) during 100 Hz doublets. The overall relationship between Fp and MMG-pp for the two different stimulation frequencies demonstrates that the changes in the force amplitude are mirrored by the changes in the MMG-pp.

In conclusion, the high correlation between Fp and MMG-pp modifications during fatiguing stimulation phase suggests that MMG could be used to follow mechanical fatigue development when force output is not detectable.

## O102B-2

**Effects of shortening vs isometric contractions on development of low frequency fatigue in isolated rat soleus muscles****Overgaard Kristian, Nielsen Ole Bækgaard**

University of Aarhus, Denmark

*Keywords: fatigue, concentric contraction, excitability*

It has been shown earlier that increases in muscle length during active contractions (eccentric contractions) increases low frequency fatigue (LFF). Other studies indicate that also muscle shortening may increase muscle fatigue. We have investigated the effects of isotonic shortening vs isometric contractions on the development of low and high frequency fatigue.

Intact rat soleus muscles with 1 cm of the nerve attached were mounted on an isotonic lever transducer hooked up in series with an isometric transducer. Changes from isometric to isotonic contractions were done by disconnecting the isometric transducer. Muscle compound action potentials (M-waves) were recorded with a monopolar electrode placed near the belly of the muscle. Contractions were elicited by supramaximal pulses delivered to the nerve via a suction electrode.

Continuous isometric stimulation for 30s at 60Hz induced a transient decrease in M-wave area and isometric force elicited by subsequent 100 Hz and 15 Hz stimulation. These parameters recovered to near control levels within 20 min. There was no sign of LFF as judged from the ratio between force production at 15 Hz and 100 Hz. Compared to these muscles, muscles fatigued by isotonic contraction against a 1.1 g load (30 s, 60 Hz), showed a more pronounced loss in the isometric force elicited by subsequent 15 Hz stimulation. Moreover, the ratio between the isometric force elicited by 15 Hz and 100 Hz stimulation was significantly reduced ( $P < 0.05$ ). These differences were present for at least 40 min after the fatiguing contraction. During recovery M-wave area showed no differences between isometrically and isotonically fatigued muscles and, furthermore, the M-wave changes corresponded well with the changes in force evoked by 100 Hz stimulation. In contrast, the changes in M-wave area could not explain the additional loss of force seen at 15 Hz stimulation in the isotonically fatigued muscles. Addition of 5 mM caffeine to the buffer 40 min into the recovery phase completely abolished the shortening-induced LFF.

Muscle shortening induces a larger degree of fatigue, especially when force was tested with low frequency stimulation. This shortening-induced LFF is unrelated to changes in membrane excitability and the myofibrillar force generating capacity, indicating that it could be caused by a shortening-induced disruption of the E-C coupling in the t-tubules, similar to what has been proposed for LFF induced by eccentric contractions.

## O102B-3

**Muscle efficiency was not changed by 7 weeks of endurance training****Hallén Jostein, Foss Øivind, Rud Bjarne, Krustup Peter, Secher Niels**

Norwegian University of Physical Education and Sport, Norway

*Keywords: training, blood flow, muscle efficiency*

An extensive research has been conducted on humans to study the effects of endurance training on maximal oxygen

uptake. However, only a few studies have focused on how training effects muscle efficiency. The aim of the present study was therefore to study the effect of 7 weeks of endurance training on skeletal muscle efficiency.

Six subjects of both sexes participated. Their age was 20-25 years, weight 66 (59-75) kg and maximal oxygen uptake 59 (50-72) ml/kg·min. Subjects trained one leg 40-100 min, four times per week, in 7 weeks on a cycle ergometer (Monark 818E). Training workload was 90 (75-115) W, corresponding to 70% (65-77) of maximal heart rate. After the training period, both legs were tested separately at three submaximal workloads (females  $n=3$  at 40, 60 and 80 Watts, males  $n=3$  at 50, 75 and 100 Watts) on an electromagnetically braked cycle ergometer at a constant cadence (80 rpm). Each workload lasted 8 min with 2 min rest in between. Blood samples were taken after 3 and 6 min at each workload from vena femoralis in both legs and in one arteria brachialis. Blood flow was determined by the thermodilution technique simultaneously in the vena femoralis of both legs immediately after blood samples were taken. Skeletal muscle oxygen uptake and lactate release were calculated from arterial venous differences and leg blood flow.

Pulmonary oxygen uptake was measured from 5-7.5 min.

There were no differences in blood flow, arterial venous oxygen difference (a-v O<sub>2</sub> diff) or oxygen uptake (Fig. 1) at submaximal workloads between the trained and the untrained leg. Lactate release during exercise was markedly lower in the trained leg than in the untrained leg ( $p < 0.05$ ) (Fig. 1). An uptake of lactate was seen in the resting legs during exercise at the highest workloads ( $p < 0.05$ ). There was no statistical difference in pulmonary oxygen uptake during exercise with the trained and untrained leg, respectively.

Leg oxygen uptake at three submaximal workloads was not different in the trained and untrained leg. However, less lactate was released from the trained leg compared to the untrained leg while exercising. However, the decreased anaerobic metabolism is not big enough to result in a significant reduction in the total energy turnover rate and therefore it is concluded that the type of training conducted in this study do not effect muscle efficiency.

## O102B-4

**Training effects after 7 weeks of pole- and normal walking****Gullstrand Lennart, Svedenhag Jan**

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*Keywords: nordic walking, training effects*

Pole walking training or Nordic walking has become a very popular form of fitness training, especially for middle-aged people in the Scandinavian countries. Pole walking training has earlier been stated to be 40-50% more effective than normal walking training. These figures may be questionably high even if the upper body is added to the training.

To test training effects, 25 middle-aged women divided in control -, pole walking - and walking groups trained for 7 weeks (55 yrs, 73,0 kg, BMI 26,5). Before and after the training period we measured sub maximal and maximal oxygen uptake (VO<sub>2</sub>), heart rate (HR), blood lactate and rate of perceived exertion (RPE). The training was performed 30 min. 3 times per week, and aimed for an intensity of "somewhat hard" to "hard" on the Borg 6-20 scale.

The results show that the walking group increased VO<sub>2</sub> max from 23,9 to 25,1 ml \* kg<sup>-1</sup> \* min<sup>-1</sup>, (+ 5 %, not sign.) The pole-walking group increased from 26,2 to 28,4 ml \* kg<sup>-1</sup> \* min<sup>-1</sup> (+ 8,4 %, sign). HR, blood lactate and RPE-values did not change significantly. Although not significant, it is

interesting to notice a 10 % decrease in RPE in arms for the pole walking group. No significant differences were found in the post measurements for the control group. In spite of just 9 hours of effective training divided on an average of 19 training sessions, pole walking resulted in significant training effects, which was not the case with normal walking.

It is however, not correct to state that pole walking training in this investigation was significantly more effective than walking. The results support the positive training effects of pole walking and it can be considered a good training method for this group.

#### O102B-5

### Three-dimensional biomechanical analysis and management of DeQuervain's syndrome in the golfer using the KinesioTaping method: a case report

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**Keywords:** kinematic analysis, kinesio taping, DeQuervain's disease

The wrist and hand are injured in professional golfers (29.6% men, 44.8% women) and less frequently in amateurs (21.2% men, 14.5% women) (1). The professional's injuries are caused by overuse (80%) (1) but amateur injuries are due to faulty swing mechanics, sudden forceful striking the ground with the club, over swinging, and grip factors.

A 42 year-old novice golfer with insidious pain, crepitus of extensor pollicis brevis (EPB) and abductor pollicis longus (APL) tendons, Finkelstein's Test before radial deviation, and unable to perform a wrist hinge test without reproducing the symptoms. Strength of EPB and APL: 3+/5. Symptoms progressed to pain with ADL and at rest. After cryokinetics, rest, controlled exercise, and NSAIDs, retinacular corticosteroid injections were performed without effect. Surgical intervention was unacceptable. Kinesio Taping Method (3) was used to reduce muscle tension and promote healing. After 4 weeks of Kinesio Taping, wrist hinge and Finkelstein's Tests improved but muscle strength and flexibility were diminished. 3D motion analysis (SkillTech, Phoenix, AZ) examined wrist release and kinematic sequence. Golf instruction and performance testing corrected physical causes and faulty motor patterns of the swing faults. Wrist set angle vs. time characterized the novice golfer (2) and "casting" swing fault with ECC EPB and APL loading. Wrist release angle range: 49.48° (top of backswing) to 160.1° (impact). No double slope (2) characteristic of expert golfer wrist release resulting in high clubhead speed at impact is noted. Novice kinematic sequence shows poor timing and peak clubhead velocity generated by upper torso and wrist/hand.

Wrist cocking and uncocking during the downswing results in maximum club head velocity (4). Uncocking too soon reduces the ability to generate maximum speeds, predisposing EPB and APL to ECC overload. KinesioTape was effective in reducing the painful symptoms and movement dysfunction.

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#### O102B-6

### Regional brain activity at different exercise intensity

Ishii Kenji, Fujimoto Toshihiko, Itoh Masatoshi, Saginoya Toshiyuki, Chida Yoshihiro, Sensui Hiroomi, Ono Yusuke, Santos Targino, Tashiro Manabu, Yamaguchi Keiichiro, Nagatomi Ryoichi

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**Keywords:** intensity, regional brain activity, PET

The purpose of this study was to examine the regional brain metabolism induced during bicycle exercise at different intensity.

Regional brain activity was detected by PET and FDG in 7 male volunteers (22.9 ± 1.6 year, VO<sub>2</sub>max 46.2 ± 2.2 ml/kg\*min). Each subject cycled at 3 different workloads (30%, 55% and 70%VO<sub>2</sub>max) using a bicycle ergometer on three separate days with an interval of more than two days. FDG (59 ± 11.2 MBq) was injected 5 minutes after the beginning of exercise and total exercise time was 35 minutes. PET emission scan started approximately 45 min after the termination of exercise. For statistical analysis, all brain images were anatomically normalized by mathematical calculation including linear and non-linear transformation to minimize inter-subject anatomical variation using SPM99. Brain images were smoothed using 16mm filter to improve signal to noise ratio. All pixel values were normalized to an arbitrary global mean value of 50 mg/100ml/min by ANCOVA, in order to exclude the effects of inter-subject variability in global cerebral glucose metabolism. A paired t-test was applied to each voxel; only voxel clusters were kept with voxels corresponding to p<0.001 in a single test and cluster size 10 voxel minimum, in one way (55% - 30%, 70% - 55%, 70% - 30%).

As compared to exercise at 30% VO<sub>2</sub>max, exercise at 55% VO<sub>2</sub>max activated a distinct region in the thalamus. As compared to exercise at 55% VO<sub>2</sub>max, exercise at 70% VO<sub>2</sub>max activated regions in the superior frontal gyrus, the right superior temporal gyrus, the cingulate gyrus and the left brainstem. As compared to exercise at 30% VO<sub>2</sub>max, exercise at 70% VO<sub>2</sub>max activated areas in the right insula, the left caudate, the bilateral cingulate gyrus and the left cerebellum. There was no marked increase in the regional brain activity of primary motor area relative to exercise intensity.

These results clearly show that the brain regions related to emotion and memory were more activated at higher exercise intensity. These areas making projections to each other may subconsciously make episode memory of the exercise experience at higher exercise intensity. Exercise of higher intensity may be beneficial for pathophysiological states in which brain activity involving emotion or memory is down regulated, such as depression or amnesia.

## O102B-7

**Changes in plasma fatty acids and tryptophan in chronic exercise in military personnel in the desert and at altitude in winter**

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*Keywords: altitude, plasma fatty acids/tryptophan, intensive training*

Tryptophan is a precursor of serotonin, a neurotransmitter involved in sleep and fatigue.

It competes with non-esterified fatty acids (NEFA) to bind to albumin in the blood, and is usually increased in exercise. There is also a link between plasma tryptophan and the inflammatory immune response. Plasma concentrations of NEFA (p[NEFA]) and tryptophan (p[FT]), together with some aspects of immune function and oxidative stress, were investigated in military personnel based in the desert but also training at moderate altitude for 4 weeks in winter (FTX).

Blood samples were taken from 60 subjects who gave informed consent: 1) At baseline in the desert; 2) 1 day after arrival at 6,800ft (FTX1); 3) Midway through FTX (FTX1b); 4) Immediately after FTX (FTX2); 5) and 6) 37 (Dsrt1) and 98 (Dsrt2) days after return to desert. Incidence of illness

questionnaires was also completed. Plasma samples were measured for amino acids, fatty acids and antioxidant capacity.

Compared with baseline desert samples: p[NEFA] was decreased by 29% at FTX2 ( $p<0.001$ ); and increased by 28% and 31% ( $p<0.01$  and  $0.001$ ) at Dsrt1 and 2; p[FT] was decreased by 46% at FTX1 ( $p<0.001$ ); by 39% at FTX1b ( $p<0.001$ ); and by 18% at FTX2 ( $p<0.05$ ), returning to baseline levels at Dsrt1. Upper respiratory tract infections (URTI) increased markedly in most individuals at FTX2. In 15 military personnel with the highest scores for URTI, there was a marginally significant 9% lower antioxidant capacity at FTX1b compared with FTX1 and 2 ( $p<0.1$ ) and 14% higher level at Dsrt1 ( $p<0.001$ ).

Increased p[NEFA] at Dsrt1 may be due to high ambient temperature and an increase in lipolysis, via increased blood flow and peripheral vasodilatation. However, p[NEFA] decreases in hypoxia in laboratory based exercise. Diet is also important in relation to fatty acids, and data is currently being analysed. Decreases in plasma NEFA, free tryptophan, and a relatively lower antioxidant capacity, occurred concomitantly with a high incidence of illness, particularly upper respiratory tract infections. The decrease in p[FT] observed might also reflect the link between tryptophan availability and the inflammatory immune response.

**Oral Session****Health and Fitness 2****O102C**

## O102C-1

**Effect of a 6-month Thai-Bo training program on endurance, power and postural balance**

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*Keywords: physical fitness, Tae Bo, training program*

Thai-Bo as a combination of elements from martial arts and classical aerobics is actually one of the most popular fitness programs. The objective of the present study was to examine the influence of a long term Thai-Bo training program on cardiovascular parameters, postural balance, and muscular strength of the knee extensor (E) and flexor (F) muscles.

Thirty-five volunteers (informed consent) participated in two groups: Thai-Bo exercise group ( $n=21$ ; mean age  $22.9\pm1.7$  years), control group ( $n=13$ ; mean age  $25.1\pm3.7$  years). Pre- and post-test with measuring of heart rate (HR), blood lactate (LA), blood pressure (RR), and rate of perceived exertion (RPE) were performed during a stepwise increasing cycle ergometry. Furthermore, isometric and isokinetic strength (Cybex NORM) of knee extension/flexion as well as postural balance on a force plate (ProvecPlus) were measured before and after a weekly six-month training period.

Our results showed a significant improvement of cardiovascular parameters in the retest (decreasing HR at a given ergometric load ( $p<0.01$ ), decreasing HR at LA thresholds ( $p<0.01$ ), decreasing systolic RR, reduced RPE). Significant increase in isometric strength ( $E=2.58\pm0.30$  vs.  $3.33\pm0.55$  Nm/kg;  $F=1.39\pm0.26$  vs.  $1.60\pm0.38$  Nm/kg bodyweight) and isokinetic strength at  $60^\circ/s$  ( $E=2.17\pm0.29$  vs.  $2.41\pm0.37$  Nm/kg;  $F=1.45\pm0.21$  vs.  $1.65\pm0.34$  Nm/kg bodyweight) could be demonstrated in addition to an improvement in postural balance, whereas the total body

sway of the training group decreased not significantly (1.93m test vs. 1.76m retest).

Cardiovascular fitness as well as static and dynamic strength can be positively influenced by a long term Thai-Bo training program. Therefore possible preventive effects can be assumed. On account of differences in individual strain during training sessions control mechanisms are recommended to adjust the individual load.

## O102C-2

**The bioenergy analysis of different seasons in Chen-style Tai Chi Chuan exercise: a case study**

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*Keywords: bioenergy, Chen-Style Tai Chi Chuan, case study*

The purpose of this case study is to investigate the conditional change of bioenergy in different seasons as a result of Chen-style Tai Chi Chuan (CSTCC). CSTCC is a kind of Chinese traditional martial art. It is a traditional Chinese conditioning exercise, consisting of 83-step graceful movements linked together in a continuous sequence, so that the body is constantly shifting from one foot to the other. In this case study, the focus of bioenergy analysis is on the twenty-four key meridian points in the human body.

Using the Detector of Channel and Acupuncture Points (DCAP) as the instrument, I tried to decide if the bioenergy value of meridian points was subject to practice CSTCC effect. The Ryodoraku theory by Yoshio Nakatani was chosen as the theoretical basis for the investigation. The study was carried out with a combination of an A/D interface, a microcomputer, and an artificial intelligence technology. This integration enabled me to automatically calculate,



analyze, and judge conditional changes of prior practice and post practice 5, 10, 20 minutes in bioenergy value, in different seasons, which was a reflection of the meridian phenomena. A t-test was conducted to identify the conditional change between prior practice and post practice 5, 10, 20 minutes of CSTCC.

The results indicate that for prior practice, the bioenergy value was significantly lower than that of post practice and there was significant difference between the seasons ( $P < .05$ ). Additionally, the meridian electric resistance decreased. And then the value of bioenergy decreased as the resting times.

In this study, the phenomenon of meridian electric resistance changing is related to the vitalized neural transfer mechanism and smoothed neural electricity, which are triggered by CSTCC exercises. These exercises manage to bring up intracellular neural transfer and cause the polarization of cell membrane. The research findings suggest that CSTCC practicing enables metabolic improvement and contributes to smooth blood circulation. The results provide implications for health preservation science.

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#### O102C-3

### **Efficacy of endurance training as an accompanying procedure in the therapy of urological tumor patients**

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*Keywords: urological tumor, exercise therapy, chemo therapy*

Epidemiological studies show that physical activity plays an important role for the primary prevention of cancer. The mechanisms being considered to be responsible for the decreased tumor growth include changes of the endocrine profile, activation of immune functions and changes of the body composition. Although most of the previous studies concerning physical activity and cancer focus on the preventive potentiation there is increasing evidence that exercise may aid the therapy of cancer. Therefore, the purpose of this study was to investigate the influence of moderate ergometer training on parameters of the immune system and the physical performance in a group of urological tumor patients during the therapy.

Up to now 23 male urological cancer patients finished the study; 14 patients belonged to the training group, 10 to the control group. Ergometer exercise training was to be performed 2-3 times per week for 3 months at a moderate training level. At the beginning of the study, after 4 weeks, 8 weeks and at the end of the study venous blood samples were taken to determine natural killer cell cytotoxicity and phagocytosis of granulocytes and monocytes. In addition, leukocyte- subpopulations were investigated by flow cytometry.

At the end of the study there was an increase in the duration of the training time and therefore an enhancement of the physical performance. No significant changes could be found for the leukocytes subpopulations due to the training. In

addition, training did neither induce an increase of the natural killer cytotoxicity nor an increase of the phagocytosis activity of the granulocytes and monocytes. In contrast, no negativ effects were detected.

In conclusion, the results show first positive trends for enhancement of physical performance in exercising tumor patients. Due to the high intra individual differences of the patients in the unspecific immune parameters the investigation of more patients is necessary for a final conclusion of this pilot study.

#### O102C-4

### **Exercise thermoregulation: effect of bed rest (BR) and training**

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*Keywords: bed rest, training, thermoregulation*

Aerobically trained subjects have enhanced thermoregulatory capacity due to increased skin blood flow and faster sweating activation. There are few studies showing that BR deconditioning results in excessive increase in internal temperature during exercise. Our hypothesis was that training modifies BR effect on exercise thermoregulation. Thus, thermoregulatory responses to exercise were measured in subjects submitted to BR before and after training.

Twelve healthy male volunteers (20.7±0.9 yrs, 74.4±8.4 kg, VO<sub>2</sub>max: 46±4 ml/kg/min) were subjected to 60 head down BR for 3 days before and after 6 weeks of endurance training (1h daily, 5 days/week). Three days before BR periods they had VO<sub>2</sub>max determined. One day before and on the first day after completion of each BR the subjects performed 45 min steady state cycle exercise at the same absolute workloads equal to 63.3% of VO<sub>2</sub>max determined before training. During all tests VO<sub>2</sub>, HR, tympanic (T<sub>tymp</sub>) and skin (T<sub>sk</sub>) temperatures (trunk, arm, thigh, forehead) were recorded every 5 min. Sweating onset and rate constant (tc) of sweating response were assessed basing on humidity of nitrogen flowing from capsule fixed on the chest. Total sweat loss during exercise was determined from differences in body mass. Changes in plasma volume (PV) were calculated from hematocrit and blood hemoglobin.

VO<sub>2</sub>max increased during training by 12.1% ( $p < 0.001$ ). Exercise HR was lowered ( $p < 0.001$ ) by training and enhanced after both BR periods ( $p < 0.001$ ). BR caused elevation ( $p < 0.01$ ) in T<sub>tymp</sub> at rest before training and during exercise before and after training ( $p < 0.05$ ). Exercise-induced increase in T<sub>tymp</sub> was enhanced ( $p < 0.01$ ) by BR only after training. Exercise mean T<sub>sk</sub> was lowered ( $p < 0.05$ ) after both BR periods. Total sweat loss during exercise, delay and tc of sweating response as well as T<sub>tymp</sub> corresponding to sweating onset were similar in all exercise tests. Heat storage during exercise did not differ among the tests. PV decreased during both BR periods (by 10±1.5 % and 9.7±1.0 %).

The results showed that core body temperature at rest and during moderate exercise is slightly elevated already after 3 days of BR. Six week training prevented BR-induced elevation of resting but not exercise T<sub>tymp</sub>. Since sweat loss and sweating dynamics were not affected, it is suggested that excessive internal temperature increase after 3 days of BR depends mainly on decreased skin blood flow due to a marked decline of PV.

## O102C-5

**Gender differences in the structure of basic abilities tested in a fitness test profile of physically active youngsters**

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*Keywords: coordination, gender difference, basic motor abilities*

Gender differences in basic abilities of humans above the age of 13 are well known. Differences in coordination are attributed to different sport experiences during their childhood. Nowadays girls often have the same opportunities as boys to exercise and train. The study is interested in whether the proclaimed gender differences are also true for physically active youngsters, especially in the field of coordination. It gives an insight into the structure of basic motor abilities (fitness test profile) of 14 year old members of regional sport squads.

In close cooperation with a secondary sports grammar school basic fitness levels were checked for male and female athletes. For this study the data of 340 students (255 male and 85 female students) were taken into account. The test profile used contained five strength tests, two tests concerning speed, two tests concerning flexibility, two endurance tests and four different tests focusing on coordination.

As expected, strongly significant differences ( $p < 0.01$ ) can be seen in all strength tests and endurance tests. Female athletes reached about 80 to 90 percent of the test scores of male athletes. In both flexibility tests the female advantages can be verified by strongly significant differences. Within the group of coordination tests only in two of the four tests no gender differences could be detected. The factor analysis shows for example that for female athletes short time endurance is located with jumping power tests, for male athletes with coordination tasks. A factor' endurance exists for the female athletes, whereas for male athletes the included tests are both assigned to coordination tasks.

Gender differences in coordination tasks ask for explanation. Different structures of factors found for the test profile make sure, that male and female athletes realize the same exercises with different limiting factors. This study shows that also for highly trained female youngsters coordinative tests show another structure than they do for male athletes. Test profiles have to be checked accurately according to the capacity of participants for whom they are used because of validity changes.

## O102C-6

**Mathematical modeling of the relationship between velocity and time to fatigue in treadmill running**

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*Keywords: running, critical velocity, critical power*

The purpose of this study was to evaluate the effect of modeling strategy on values of critical velocity ( $V_{critical}$ ) and anaerobic work capacity (AWC).

Thirty-five university students performed five to seven constant-velocity 0%-slope treadmill running tests at velocities that elicited fatigue in ~3 min to ~8½ min. Velocity and time data were fitted using a two-parameter ( $V_{critical}$ , AWC) hyperbolic modeling strategy, a three-parameter ( $V_{critical}$ , maximal power ( $V_{maximal}$ ), AWC) hyperbolic modeling strategy, a three-parameter ( $V_{critical}$ ,  $V_{maximal}$ , tau) exponential modeling strategy, and a three-parameter ( $V_{critical}$ , AWC,  $VO_2$  time constant) hyperbolic modeling strategy.

All strategies described the velocity-time relationship well (mean  $R^2 = 0.982$ ). However, the exponential model generated three parameters, two of which have little apparent physiological meaning, with relatively large SEE.  $V_{maximal}$  and the SEE from the three-parameter hyperbolic model was so high that the  $V_{maximal}$  parameter was considered superfluous and the model was deemed vacuous for the range of exercise durations used in this study. The three-parameter hyperbolic modeling strategy that generates the time constant of the  $VO_2$  response merits further evaluation.

The two-parameter model is preferred because it provides a parsimonious description of the relationship between velocity and time to fatigue over the range of exercise durations used and it produces parameters of known physiological significance, with excellent confidence.

## O102C-7

**Impact of physical activity on the radius geometry of prepubertal girls**

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*Keywords: lean mass, cortical thickness, radiogrammetry*

Physical activity during growth has been reported to enhance the bone mineral content (BMC) and density (BMD). The aim of this study was to determine the impact of physical activity on the radius geometry in prepubertal girls.

BMC and BMD were measured at the third distal of the non-dominant radius (1/3R) using DXA in 23 gymnasts and 27 controls aged  $10.29 \pm 1.40$  years. Lean mass (LM), BMC and BMD values were derived from the whole body analysis using the same device at the non-dominant forearm. A standard radiograph of the non-dominant radius performed in all subjects was then digitised with a high resolution scanner (256 grey level). The resulting images were computed by our home-made program based on radiogrammetry to generate cortical thicknesses (CT) of the ulnar (u) and radial (r) sides.

The greater activity of the gymnasts compared to controls ( $6.9 \pm 3.8$  vs  $1.17 \pm 0.78$  hours per week,  $p < 0.001$ ) resulted in significant higher values for CTU ( $p < 0.01$ ), BMC ( $p < 0.001$ ) and BMD ( $p < 0.01$ ) both at the NDF and 1/3R. After adjustment for the weekly duration of practice, the difference between gymnasts and control for CTU disappeared. In a regression analysis, non-dominant forearm LM explained 14.5 % of the variance of CTU.

Although a large proportion of the bone gain was related to growth, an osteogenic effect was associated with physical activity. These results suggest that gymnastics might be beneficial for cortical bone gain in prepubertal girls.

## Symposium

### Education through Sport

S102D

#### S102D-1

##### Sports activities and development in young people

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*Keywords: education, self-concept*

The assumption that sports activities make an essential and positive contribution to the development of personality can look back on a long tradition, especially in the theory of PE in many countries, and continues to be extremely topical. However, empirical attempts to find evidence for this educational view have so far had little success and have produced inconsistent findings. The causes are seen as being inadequate theoretical conceptualisation and, just as frequently, deficiencies of method. The problem, the theory and empirical research are mostly insufficiently interlinked. Against this background, a series of longitudinal studies attempted to comprehend the construct of personality by means of partial theories and to identify unidirectional effects of sport on the development of the adolescent personality. The findings are as follows: The athletes' study found that no increased risk to development can be detected in adolescents involved in competitive sport as compared with young people with no particular sporting commitment and it failed to find evidence that adolescents' development benefits from top-level sport. Similarly, no significant developmental advantages over other adolescents can be discerned among teenagers involved in competitive club sport. Among the 9- to 11-year-old children, the situation is slightly different. Sports activities in this group seem to produce significant effects in some areas of the self-concept - even if only tendentially and to a moderate extent. The studies also failed to provide clear answers to the question of what effect sporting activity has. Satisfactory results are probably not to be expected until nomothetic and idiographic approaches, qualitative and quantitative data from cross-sectional and longitudinal studies, are combined.

#### S102D-2

##### Victory, violence, and values: balancing fair play and winning in sport

**Rees Roger**

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*Keywords: values, fairness, victory*

This paper extends preliminary research findings on the complementary relationship between fair play and victory to the fair play values of 165 college physical education majors, 741 elite high school athletes from 27 school districts on Long Island, NY, and 14 physical education teachers and coaches. Qualitative and quantitative analysis of questionnaires, open-ended responses and in-depth interviews showed that respondents' perceived fair play as "expressively" important because it was how the game ought to be played, and "instrumentally" important because without fair play the victory was worthless. Further analysis of injury scenarios revealed the "contextual" nature of fair play values.

Specifically, while injury was seen as very much "part of the game", intentional injury as an instrumental tactic was strongly rejected. The importance of fair play existed in conjunction with a number of potentially conflicting values about behavior and rule violation during interaction between respondents and teammates, opponents, coaches and referees. In their personal fair play anecdotes, respondents recalled respect shown for opponents, teammates, and themselves during and after intense competition, acts of concern and compassion shown by opponents during injury incidents, and moments of self-control under pressure.

These responses implied that fair play and victory are among a number of values more or less held in balance, or "negotiated", in competition where trash talking, cheating and illegal tactics are common. Such a conceptualization of fair play is at odds with the accepted version that athletes use "game reasoning" in sports to justify a "win at all costs" perspective, including the perception that intentional injury to an opponent is a legitimate tactic. Instead of a perspective in which victory and violence go hand in hand, the results of this research showed that respondents' valued fair play, and balanced a commitment to it with a desire for victory within a matrix of values about how to behave in sports. Values in sports, like values in everyday life are mediated by issues of competition and compromise, but are not sacrificed for violence in the pursuit of victory.

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#### S102D-3

##### Education to fitness and an active lifestyle - a challenge for physical education

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*Keywords: physical education*

In many countries health and physical fitness are connected to the objectives in physical education. The purpose of this report is to present some current findings on physical fitness and healthy lifestyle among youth and discuss about the meaning of these objectives in physical education. The findings are based on two large Finnish research projects.

The results show that leisure time physical activity measured by sport club activities and non-organized physical activity has not at least decreased during last decade, on an average. At the same time in some of the indicators of physical fitness the results have decreased. It seems that there has happened a polarization in sport and physical activity among youth. On one hand there is a group of young people which is more active in sports than youth 15 years ago, and its physical fitness is at least at the same level as then. On the other hand we have approximately same amount of physically passive young people as before, but because of the more passive lifestyle in every day life their physical fitness, and according to some findings, also their functional capacity is lower.

The group of physically passive young people is in many ways a challenge for physical education. According to the results in Finland the size of the group is about 20 % of the age group. It is, however, not a single group, but consists of different lifestyles. It is also important to understand, that we have not reached these individuals by using traditional teaching methods and contents in PE. Therefore we need innovations to create new environments for physical activity, to motivate those young people in any physical activity, not only in traditional individual and team sports.

It is also necessary to make difference between societal and individual goals. The experts in physical education should have more evidence-based knowledge about the effects of physical activity on health, in order to answer to the questions of decision-makers. However, at individual level there are many other important motives for sports and physical activity than health and physical fitness, especially among children and youth. The professionals in physical education are expected to have expertise also in socializing different individuals into active lifestyle.

S102D-4

### Providing a relevant PE curriculum for children and young people

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Keywords: physical education

The pace of social change and the accompanying complexity of the social, moral and economic context of education constantly question assumptions about the aims of education, what is worth teaching and the values which should be promoted in schools. Deciding what is a relevant education for children and young people is a complex matter and for young people their willingness to engage with schooling in general, or particular aspects of it, is often

related to its relevance for them and their lives. However, the structuring of learning experiences to accord more closely with students' own frameworks of reference and the context of their lives has some way to go. Among the implications for PE is Green's (2002) point that whilst sport and physical activity are very much part of young people's lifestyles their popularity is often contingent upon being presented appropriately, which for many students means so-called "lifestyle activities". He indicates that PE needs to harness the flow of youth culture, in other words to tap into the world of young people and what is relevant to their situation. However, Lake (2001) confirmed that students express their orientation to PE through discourse concerned almost exclusively with competitive team and individual sports. This meets the immediate needs of a number of students but fuels disengagement amongst others and significant drop out in the post-school period. Laventure (2002) called for greater emphasis on „lessons that last a lifetime“ which he suggests does not flow automatically from traditional PE programmes. Furthermore, as Groves (2001) has shown, we need to uncover further the frameworks used by students during their involvement with PE, their perspective both of the curriculum in general and what she refers to as their 'working consciousness' during lessons.

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Lake, J. (2001) *Young people's conceptions of sport, physical education and exercise: implications for physical education and the promotion of health-related exercise*. *European Physical Education Review*, 7, 80-91.

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## Oral Session

### Traumatology

O102E

O102E-1

### Impact of experimentally induced shoulder pain on shoulder muscle function during dynamic movements

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Keywords: EMG, shoulder, pain

Pain in the shoulder is a very common complaint in the population and it is very difficult to treat. The rotator cuff is especially prone to extensive strain in repetitive movements above shoulder level and the risk of injuries is increased. Pain, as the sole mediator, in the shoulder has been suggested to change the muscle function. How acute or chronic pain influence shoulder muscle function has not been clarified yet. The aim of this study was to examine the effect of experimentally induced pain on shoulder muscle function. 7 healthy young men (22-27 years) with no history of previous or current shoulder injuries were included in this study. The subjects had intramuscular wire electrodes inserted in the supraspinatus and the infraspinatus and surface electrodes were placed over 6 superficially located

shoulder muscles for electromyographic recordings (EMG). The subjects performed MVC's followed by dynamic abductions and external rotations. Then pain was induced by a 5 % hypertonic saline injection in the supraspinatus and the dynamic movements were repeated. The subjects had another injection of hypertonic saline in the subacromial space and performed the dynamic movements again. During the dynamic movements pain was scored on a visual analog scale (VAS).

During abduction and when pain was experimentally induced in either the supraspinatus or subacromially, the supraspinatus showed an increase in activity from 80 degrees and throughout the abduction. Infraspinatus revealed an increase in activity from 25 degrees and onwards. The lower trapezius had a marked increase in muscle activity throughout the entire movement. During external rotation and pain induction in either the subacromial space or in the supraspinatus the supraspinatus showed a decrease of muscle activity. The infraspinatus did not show a uniform pattern until 75 degrees of external rotation when pain caused a decrease in muscular activity. The lower trapezius had an increase of activity in the interval 25-75 degrees of external rotation when pain was induced in the supraspinatus

and an increase from 0-75 degrees when pain was induced subacromially.

This study showed that pain had an impact on muscle activity in the shoulder muscles. Even though there is not a uniform pattern of the changes caused by experimentally induced pain this study indicates that pain has a strong influence on the muscle activity of the shoulder muscles during voluntary movements.

#### O102E-2

### Upper extremity function in chronic lateral epicondylitis

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**Keywords:** *muscle strength, rehabilitation, sport traumatology*

The limitation in the function of arm in lateral epicondylitis has been demonstrated by using clinical manual tests, pain and grip strength measurements. Also, restricted range of motion of the elbow has been demonstrated, although the muscles associated with epicondylitis are those for wrist movements. The aim of this study was to investigate the functional limitations of the arm and elbow in chronic lateral epicondylitis.

Totally, 36 patients, 16 males and 20 females, mean age 41.9 years and mean duration of symptoms 44.5 weeks, with chronic unilateral lateral epicondylitis were studied using pain questionnaire, pain drawing, grip strength and isokinetic performance measurements of the wrist, forearm and elbow. The concentric isokinetic performance was evaluated at radial velocities of 45, 90 and 180 degrees/s at all sites.

Compared with the healthy arm, the isometric grip strength was declined by 18 % ( $p=0.003$ ), and isokinetic torques and work showed highest decreases in wrist flexion (-20 and -26 %,  $p<0.001$ ), forearm pronation (-17 and -18 %,  $p<0.001$ ), in elbow flexion (-13 and -16 %,  $p<0.001$ ) and in elbow extension (-16 and -20 %,  $p<0.001$ , 0.0001). The decreases were highest at 90 and lowest at 180 degrees/s. The decrease in elbow isokinetic performance was correlated with decreases in grip strength ( $r=0.56, p<0.01$ ), working disability ( $r=0.38, p<0.05$ ), duration of symptoms ( $r=0.45, p<0.01$ ) and pain threshold decrease ( $r=0.42, p<0.05$ ). The limitations were not correlated with pain scores and were most prominent in elbow extension and in wrist flexion.

Although the elbow movements are not primarily associated with the pathologic structures involved in lateral epicondylitis, the elbow function is also considerably limited in lateral epicondylitis. The results indicate a complex functional loss in the function of the upper extremity in prolonged symptoms of lateral epicondylitis, which must be considered when planning treatment and rehabilitation programs for the disorder.

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*Pienimäki T et al (1997). Eur J Phys Med Rehabil 7, 6 Dec, 171-178*

#### O102E-3

### Variation in functional stability of the knee joint after ACL rupture, surgery and rehabilitation

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**Keywords:** *ACL, knee joint, functional joint stability*

The purpose of our study was to compare functional outcome of ACL deficient, physical active subjects with or without surgical treatment. Besides the mechanical stability of the knee joint, the amount of neuromuscular activation in joint stabilization was of special interest.

32 subjects with arthroscopically confirmed unilateral ACL-rupture participated in the study. The subjects were divided into a surgical and a non-surgical group. First measurement took place immediately after arthroscopic diagnosis, the second measurement six months and the third measurement nine months later. Surgical treatment was performed three months after diagnosis for the surgical group. Functional knee joint stability was measured in simulations of injury mechanisms with a dynamic anterior tibial displacement, while the leg of the subjects was axially loaded. Tibial displacement and reflex activation of stabilizing muscles were measured. Postural stabilization was measured on a stance platform with a medial-lateral stimulus. Postural sway, knee joint movement and neuromuscular activation of the knee joint muscles were measured.

The tibial displacement in the injured leg of the surgical group was clearly enhanced before surgical treatment while it was not in the non-surgical group. The surgical group had on average more neuromuscular preactivation in the injured leg. During the postural stabilisation task, the surgical group reduced their knee joint movement significantly, the non-surgical group enhanced their knee joint movement in their injured leg up to 125% of the uninjured leg from first to last measurement. While the neuromuscular activation of the hamstrings in the surgical group remains on a high level, the activation in the injured leg of the non-surgical group decreases to less than 70% of the uninjured leg, in the last measurement.

Functional instability in low stress situation in the simulation of injury mechanism may have an influence on the decision for surgical treatment. The surgical group prepared to the stimulus with higher preactivation. Looking at the neuromuscular activity of the hamstrings, the increasing instability of the injured knee joint in the non-surgical group may be related to a decreasing muscular stabilization. These results suggest an increasing risk for re-injury over the time for the non-surgical group.

#### O102E-4

### Effects of total knee arthroplasty on gait symmetry

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**Keywords:** *gait analysis, ground reaction force, total knee arthroplasty*

In healthy subjects, gait patterns with respect to time, distance and vertical ground reaction force (GRF) are fairly symmetrical deviating only by a small percentage from perfect symmetry (Herzog et al. 1989). Osteoarthritis of the knee can be extremely painful and thereby affect gait symmetry, strength and flexibility (Messier et al. 1992)

resulting in decreased functional ability. The total knee arthroplasty (TKA) is a surgical procedure that usually results in a marked decrease in pain and in a concomitant improvement of the functional capacity of patients. GRFs have been used to quantify abnormal limb loading for individuals prior to and after TKA. The purpose of the present study was to examine changes of the loading patterns before and 12, 26 and 52 weeks after the TKA.

Subjects (n=15) walked on a 10-m long force platform at their freely chosen speed (mean  $1.08 \pm 0.09$  m.s<sup>-1</sup>). The asymmetries of GRF patterns were examined using the magnitude of the symmetry index (SI) (Herzog et al. 1989). The following vertical GRF variables were measured: the first peak during early stance phase and the time when it occurred; the second peak force during the push-off phase. Loading rate was calculated as magnitude of the first peak force divided by time at which it occurred.

There were no statistical differences between the pre- and postoperatively on GRF and contact time values. Stance time was decreased from  $0.74 \pm 0.15$ s to  $0.67 \pm 0.10$ s when the first peak force was slightly increased ( $1.06 \pm 0.11$  BW to  $1.08 \pm 0.06$  BW). Time to the first peak force was decreased from  $0.21 \pm 0.1$ s to  $0.18 \pm 0.05$ s. There were significant differences ( $p < 0.05$ ) in SI for the loading rate (-19.9%) and time to the first peak force (18.3%) variables between unaffected and affected limb preoperatively and 12 weeks after TKA.

Bilateral asymmetric limb loading persisted well (SI < 10%) after unilateral TKA. Before surgery there were surprisingly few changes on the SI. Loading rate was higher on the unaffected side due to higher force development rate. In addition, stance time showed a trend for longer contact times on the unaffected limb during the one year follow-up. These results suggest that knee joint stiffness of the affected limb has decreased due to osteoarthritis and that TKA may normalize the gait pattern, possibly due to reduced pain.

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Messier Sp et al. (1992) *Arch Phys Med Rehabil* 1992; 73: 29-36.

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#### O102E-5

### Jumper's knee physiopathology: Influence of postural disequilibrium

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**Keywords:** knee, tendinopathy, overuse injury

Patellar tendinitis continues to afflict a big number of athletes engaged in sports related on skips and jumps. Aim of this study was a clinical and postural evaluation of athletes to check whether presence of postural disequilibrium may be associated with jumper's knee and whether reversibility of this leads to a remission of symptoms.

45 athletes, 23 male and 22 female, from 12 to 25, practising different sports (soccer, basket, tennis, volley, jumpers in athletic fields), with echographic or MRI diagnosis of patellar tendinitis have undergone clinical tests, lower limbs telerradiography and postural evaluation with balance. This device is constituted by independent platforms supported by cells able to show in real time an asymmetric skeletal control and leg-length discrepancy. Conservative therapy is based on correction of the action, muscular strengthening and plantar orthosis, followed by a new postural check at two months.

All athletes showed an overload estimated by 1 to 20 Kg at one lower limb and a asymmetry from 2 to 17 mm with Balance. No correlations were found with dominant and affected side. Radiological inquiries revealed significant correlations with these data. In two months, painful symptomatology disappeared and a postural equilibrium was maintained.

This study highlighted that among pathogenetic factors of jumper's knee there is a postural imbalance linked and how relevant the asymmetry of lower limbs to therapeutic results is. The assessment of young athletes' posture can discover new pathogenic factor. It permits to establish adequate therapy and to solve painful symptomatology followed by limitation or abandonment of sports activity.

#### O102E-6

### Injuries from snowmobile accidents - a 10-year survey of patients treated in Lapland Central Hospital

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**Keywords:** injury, snowmobile

Snowmobile driving is very popular in Northern Finland, not only as a leisure time activity or competition sport, but there are also snowmobile safaris for tourists or snowmobiles are used for work purposes. Little evidence is available on the type of injuries that are most commonly associated with snowmobile accidents. This information would be valuable to plan protective measures. Former studies have stated a high percentage of injuries of the upper and lower limb but no detailed classification of the injuries has been done. Therefore the aim of the present study was to investigate the type and specific location of snowmobile related injuries of patients treated in Lapland Central Hospital during 10 years with special emphasis on the survey of injuries of the upper and lower limb.

All patients that had been referred to Lapland Central Hospital either directly or via a health care centre during autumn '91 through spring '01 because of a snowmobile accident were included in the study. For each patient a standardized questionnaire was filled in to obtain information about the injured person, kind of accident, weather and snow conditions, driver's experience level etc. The kind of injury and diagnose(s) were added by a doctor.

559 patients were included in the study; the average age was  $35.3 \pm 14.5$  years. Most injuries occurred in the lower limb (42 %), followed by the upper limb (26%). Of the lower limb knee injuries had the highest incidence (14% of all injuries), in the upper limb the shoulder was most often affected (6%). Most of the injuries of the limbs were fractures, however, in the knee ligament and meniscus injuries and in the shoulder luxations were more common than fractures. The three most common injuries were shaft fractures of the lower leg, femoral shaft fractures and distal radius fractures. The left limb was almost twice as often affected as the right leg while we found no difference in the upper limb regarding the side of injury.

The results regarding the location of injury are consistent with other studies, which report an incidence of 50-70 % for injuries of the limbs. When interpreting the results it must be kept in mind that the material studied was restricted to patients treated in Central Hospital. Contusions and distorsions as well as common fractures of the clavicle or wrist were not necessarily referred to the hospital but treated in a local health care centre and therefore not included in the study.

## O102E-7

**Football injuries during the World Cup 2002 - analysis and comparison with previous tournaments****Junge Astrid, Dvorak Jiri**

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*Keywords: injury, football, tournament*

The FIFA World Cup is one of the largest, most popular sporting events, but it is associated with a certain risk of injury to the participants. It has been reported that the incidence of injuries differed substantially between tournaments due to the player's different age, sex and skill-level. The aim of the present study was to analyse the incidence, characteristics and circumstances of football injuries during the 2002 FIFA World Cup Korea/JapanTM and to compare the data with previous international football tournaments.

The physicians of all participating teams were asked to report all injuries after each match on a standardized injury report form. The report form required documentation of the following: shirt number of the player, minute of the match, injured body part and type of injury, circumstances and consequences of injury. All 128 injury report forms from the 64 matches of the 2002 FIFA World Cup Korea/JapanTM were filled out and returned by the team physicians.

A total of 171 injuries were reported, which is equivalent to an incidence of 2.7 injuries per match or 81.0 injuries per 1000 match hours. The body parts injured were predominantly the thigh and the lower leg. Injuries of the head and neck, knee and ankle were also frequent. Only one third of the injuries (53 of 160) reported did not result in subsequent absence from training or matches. More than half of the injuries (n=86; 54%) resulted in absence from football up to one week, 18 injuries (11%) in absence for 8 to 28 days, and three injuries in absence for more than 28 days. Significantly more non-contact injuries (88%) than contact injuries (59%) resulted in subsequent absence from training and matches, and the estimated duration of absence was longer for non-contact injuries than for contact injuries.

The incidence of injuries during the 2002 FIFA World Cup in Korea/JapanTM was slightly higher than in the FIFA World Cup in France 1998, but substantially lower than in the FIFA World Youth Championships 1999 and 2001 and in the football tournament of the Olympic Games in Sydney 2000. The proportion of non-contact injuries during the 2002 FIFA World Cup in Korea/JapanTM was more than twice as high as in other football tournaments for male football players. Standardized assessment of sports injuries provides not only important epidemiological information, but also indications for injury prevention and the opportunity for monitoring long-term changes in the frequency and circumstances of injury.

**Symposium****New Trends in Sport-Physiotherapy****S102F**

## S102F-1

**Evidence based sports physical therapy: The influence of elastic bandage as a means of increasing muscle activity of the m. rectus femoris.****Cabri Jan, Oliveira Raul**

Faculty of Human Kinetics, Portugal

*Keywords: EMG, isometrics, taping*

To verify the effect of an elastic tape technique on muscle activity and strength developing capabilities.

Eighteen healthy young men and women (8 men and 8 women, age range 21-29 years) participated to the study. Exclusion criteria were: any knee injuries, three years prior to the study) and informed consent was signed by all subjects. A trained and experienced physiotherapist fixed the elastic tape (Kinesiotape, Kinesio Taping, Yotsuya, Japan) on the M. rectus femoris of the dominant leg. Prior to the tape fixation, the skin of the subjects was cleaned with a mixture of alcohol and ether, after which two silver-silver chloride electrodes were fixed on the muscle belly of the referred muscle. Electromyographic (EMG) signals of the M. rectus femoris were recorded during the actual test, using a Biovision EMG System (Biovision GmbH, Wehrheim, Germany). The EMG data were then normalized to the maximal EMG activity and integrated over a two-second window. The test consisted of five six-seconds maximal isometric efforts (leg extension in a closed kinetic chain condition) of the dominant leg on a leg press - the ankle and the knees were flexed at 90°, the hips at 120°. The rest periods between the exercises were two minutes. Simultaneously with the EMG recordings, the force signal from the force plate of the leg press was recorded at the same sampling frequency, also. The tests were carried out in

two conditions: with or without tape. The order of test condition was randomized.

Paired Student-T tests showed no significant differences between the test conditions with respect to the integrated and normalized EMG values and the isometric force data ( $p > 0.05$ ). During the last two seconds of the isometric efforts, strength was significantly reduced in both conditions (mean difference: 55.1 N without tape, 71.8 N with tape). However, the mean differences between the test conditions were not significant.

From the results obtained, it can be concluded that, the elastic tape technique as applied in the present study, do not influence neither the muscle activity nor its output.

## S102F-2

**3D joint kinematics: Applications in sports physical therapy****Baeyens Jean-Pierre, Van Roy Peter, Cattrysse Eric, Clarijs Jan-Pieter**

Vrije University of Brussel, Belgium

*Keywords: physical therapy, arthrokinematics, sports medicine*

Following the convex/concave rule -a pivotal concept in manual therapy- the roll and glide of a convex humeral head on a concave glenoid should be in opposite directions. However, in the case of glenohumeral external rotation, in vivo clinical studies demonstrated a posterior translation of the humeral head on the glenoid (Baeyens et al., Rhoad et al.) evolving out of specific capsuloligamentous tightening. As such, the morphology of the articular surfaces is not the constituting factor of coupled rotations/translations in the joint. Consequently, the clinician must reconsider

Kaltenborn's traditional concepts regarding intra-articular motion behaviour as well as restating its clinical impact.

Furthermore, roll and glide are arthrokinematic terms related to the plane of motion. From an individual point of view it is difficult to define therapeutically the plane of motion as well as the articular surface and thus the magnitude and direction of glide. Consequently, from a practical point of view it seems better to redefine manual therapeutic techniques for the glenohumeral joint in terms of rotation of the humerus and translation of the center of the humeral head.

Perhaps more difficult than measurement of spatial motion is the unambiguous description of it. The helical (or screw) axis motion approach describes the displacement of a body from one position to another as a rotation about and a translation along an axis with specific orientation and position. Euler/Cardan conventions represent joint motion by the description of three ordered (i.e. sequence dependent) rotations of an embedded coordinate system and the translation of its center. Though the description of motion in terms of Euler or helical angles may be complete, therapeutic interpretation of the results may become difficult. For instance, our in vitro results reveal for extension of the ulna on the humerus, the combination of valgus/exorotation/extension in terms of Cardan angles and the motion pathway of varus/exorotation/extension in terms of helical angles. The problems associated with this are obvious: What to do with a patient having an extension deficit? Should one use varus or valgus techniques?

Baeyens J-P et al. (2001). *Clinical Biomechanics* 16: 752-757.

Rhoad, R.C. et al. (1998). *Skeletal Radiol* 27: 92-97.

## S102F-3

### The influence of estrogen on knee injuries in female athletes

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Syracuse University, United States

**Keywords:** knee injuries, estrogen, females

Serious knee injuries are much more common in female compared to male athletes, and a projected 50,000 such

injuries occur in female athletes in the United States every year. The primary injury observed has been tears of the anterior cruciate ligament (ACL), and ACL tears are 2-8 more common in females than in males. Most of these injuries occur during non-contact activities, such as jumping or pivoting during running. Several mechanisms of these injuries have been proposed, including anatomical, neuromuscular and hormonal factors. Recently, hormonal factors, particularly variations in estrogen during the menstrual cycle, have been investigated as potential explanations for increased ACL injury rate in females.

Estrogen may have direct physiologic influence on ligament structure and function. Female connective tissue exhibit hormone receptors for estrogen and animal data show estrogen can decrease both collagen content and synthesis. Estrogen also influences the neuromuscular system. Several negative effects have been demonstrated, including decreased fine and gross motor control, and changes in skeletal muscle control, including changes in quadriceps muscle function. Central nervous system decrements have also been noted resulting in reduced decision making ability.

Several recent studies have shown that ACL injuries in women vary with the menstrual cycle. The injury rate during the ovulatory phase was 2-3 times higher than expected, but 40-200% lower than expected during the follicular phase. Several studies have also shown a higher injury rate during the first few days of menstruation. Further support for the impact of estrogen on ACL injuries have provided by showing that women taking oral contraceptives show no difference in injury rates between the different phases of the menstrual cycle and the overall injury rate is also lower in women taking oral contraceptives.

There is a clear relationship between variations in estrogen levels and ACL injuries in women. Oral contraceptive therapy may provide some protection, but must be considered on an individual basis. Other preventive strategies include dynamic neuromuscular training.

## Symposium

### Neuromuscular-skeletal Adaptation and Aging

S102G

## S102G-1

### Adaptation of bone to exercise and injury

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**Keywords:** exercise, injury, bone

Bone adapts to altered mechanical stimuli or injury. Exercise, generally, helps to maintain bone mass and counter age-related osteoporoses, but highly strenuous exercise can also have detrimental effects on bone-particularly for immature bone. The ability of bone to change its morphology in response to local physical stimuli is predicated upon the appropriate recruitment of bone cell populations. In turn, the ability to initiate cellular recruitment is influenced by both local and systemic factors. We have examined the microstructural changes in periarticular cancellous bone structure via micro-CT ( $\mu$ CT) scanning and mechanical

properties and blood flow in the chronically unstable knee joint.

We found that joint injury (loss of anterior cruciate ligament) had profound and deleterious effects on the structure and mechanical integrity of the periarticular bone. Our current projects are assessing whether bisphosphonate therapy blocks remodeling and conserves bone and joint integrity. Our group is probing relations between local mechanical stimuli (e.g., strain gradients, strain magnitudes, and strain rate) and the sites of bone formation induced by exercise. In mature roosters, we measured the strain in the tarsometatarsus during strenuous running.

Surface mineralization sites in the tarsometatarsus cross-section correlated significantly with induced peak circumferential strain gradients, suggesting a link to fluid flow between compressive and tensile regions of the bone. To assess how strain rate affects bone adaptation, we studied immature roosters that performed repeated high-impact drop jumps. The drop jump protocol produced significant bone



formation at the endocortical surface of the immature tarsometatarsus that correlated with circumferential distribution of peak strain rates. To further study the mechanisms that contribute to mechanotransductive adaptation, we are determining strain gradients, strain rates, and fluid flow in an in vivo adult mouse model. Secondly, we are establishing the relations between fluid flow and localized regions of bone adaptation. Experiments involve a combination of high-resolution imaging, finite element modeling, and animal-specific controlled-loading models, and allow us to determine how strain gradients and rates potentially influence mechanisms of bone adaptation. Elucidation of the strain parameters important in bone adaptation may underpin countering bone decrements associated with age-related osteoporoses.

### S102G-2

#### **Muscle architecture and tendon mechanical properties in ageing and disuse: effects of physical activity**

**Narici Marco, Maganaris Constantinos, Reeves Neil**

Manchester Metropolitan University, United Kingdom

*Keywords: hip arthroplasty, hip abductor, hip joint*

In both ageing and disuse, strength decreases more than muscle size. Clearly, other factors, in addition to atrophy, contribute to this disproportionate force loss. The following findings suggest that changes in muscle architecture and tendon mechanical properties significantly contribute to muscle weakness but may be mitigated by physical activity. Plantarflexors (PF) and knee extensors (KE) adaptations to disuse, ageing and resistive training were investigated using dynamometry, ultrasonography and MRI.

PF torque, cross-sectional area (CSA), architecture and tendon stiffness were measured in 10 young males (YM) (27-37 years) before and after a 90 day-bed rest. Six individuals did not perform training (NT), 4 performed PF resistive training (T). Resting gastrocnemius medialis (GM) muscle architecture was measured in 19 old males (OM) (65-81 years) and compared to 13 YM (27-42 years). The OM group underwent 16-week training. Vastus lateralis (VL) architecture and tendon stiffness were evaluated in 14 OM (65-80 years), 7 underwent 14 week KE training (T) and 7 were non-training controls (NT).

After bed rest, maximum isometric force decreased by 55% and muscle CSA by 32%. GM resting fascicle length decreased by 7% in the T and 9.2% NT groups. Resting pennation angle decreased by 13% in both groups. Fascicle shortening upon contraction decreased by 17% in T and 35% in NT groups. Tendon stiffness decreased by 32%, with a 128% increase in time to peak force. Similarly, in YM resting fascicle length and pennation angle of OM (65-81 years) were 8% and 13% smaller than those of YM (27-35 years). After 16-week PF training, muscle volume increased by 13% but no increase in pennation angle was observed, however, fascicle length increased by 4%. After 14 weeks KE training, tendon stiffness increased by 64%, with a 27% increase in the rate of torque development. Differently from the GM, VL fascicle length and pennation angle increased by 8% and 35%, respectively. At the same joint angle, VL fascicle shortening upon contraction was 10% before and 7% after training.

Following these changes in fascicle length and tendon stiffness, fibres were still thought to operate within the same region of the length-tension relation. Changes in muscle architecture and tendon stiffness substantially contribute to the loss of muscle strength in ageing and disuse. These

training-induced adaptations are important for preventing muscle weakness and for maintaining locomotory function in old age and following disuse.

### S102G-3

#### **Neural activation of skeletal muscle and ageing**

**De Vito Giuseppe, Macaluso Andrea**

University of Strathclyde, United Kingdom

*Keywords: EMG, neural activation, steadiness*

The finding of lower specific strength, expressed as the ratio between muscle force and pure contractile mass (Macaluso et al, 2002), suggests that mechanisms other than smaller muscle mass account for differences in force production between young and older individuals. These include, among others, the neural activation of skeletal muscle, which can be studied "non-invasively" by surface electromyography (sEMG).

SEMG amplitudes have been shown to be lower in older than young individuals (Macaluso et al, 2002; Merletti et al, 2002), which has been attributed to a lower number, firing rate or synchronisation of the recruited MUs. Another neural factor which contributes to the age-related decline in muscle force generation capacity is the level of coactivation of antagonist muscles. Higher levels of antagonist coactivation have been observed in healthy women in their seventies as opposed to those in their twenties (Macaluso et al, 2002).

During a sustained fatiguing contraction there is a decline in parameters of the power spectrum and in the action potential muscle conduction velocity in both young and older individuals (Merletti et al, 2002; Bazzucchi et al, 2003). However, the rate of decrease in these parameters has been shown to be lower in the older. Therefore the older muscle would be more resistant to fatigue (fatigue-paradox), which can be ascribed to selective atrophy of type II fibres, slowing in the contractile properties and lower MU firing rates of the older muscle.

It is still debated if older adults are able to maximally activate a muscle or muscle group. Most of the investigators demonstrated that a superimposed stimulus added little or nothing to the volitional force of older people (Scaglioni et al, 2002).

Older individuals are less steady than young individuals in maintaining force within a given target at either low (Enoka et al, 2003) or high (Bazzucchi et al, 2003) intensity of muscle contraction, but not at moderate levels. However, the physiological mechanisms underlying this phenomenon still have to be clarified.

*Bazzucchi I et al (2003).*

*Enoka RM et al (2003). J Electromyogr Kinesiol 13: 1-12m.*

*Macaluso A et al (2002). Muscle Nerve 25: 858-63.*

*Merletti R et al (2002). Muscle Nerve 25: 65-76.*

*Scaglioni G et al (2002) J Appl Physiol 92: 2292-302*

### S102G-4

#### **Functional implications for strength training exercises in the elderly**

**Gollhofer Albert**

University of Freiburg, Germany

*Keywords: elderly, sensorimotor training, strength exercises*

The dramatic increase in the ageing population is the major impact to initiate medical, social and economical re-search programs in most of the industrial countries. The problems

associated with the alterations are multidimensional in nature and not intensively studied in the past decades. The questions how to take care of the ageing people needs to be answered in the ensuing years. Ageing is associated with involution of physical, functional, mental and social capacity, consequently limiting the quality of life. In addition to the increased incidence of chronic diseases, one major but often ignored consequence of ageing is a drastic decline in total muscle mass. This may lead to increased occurrence of metabolic derangements, and generalized frailty. It has been frequently reported that human muscle strength and the ability to develop explosive force decrease with increasing age (Häkkinen 2003). The consequence is a general slowing down of neuromuscular performance. The principal mechanisms responsible for this phenomenon are decreases in the number of large alpha-motoneurons accompanied by a reduction in number and size of type-II skeletal muscle fibres (Lexell et al. 1988). Muscle strength and the ability of the leg extensor muscles to develop force more rapidly are especially in old age important factors that help managing activities and necessities of daily living and may prevent elderly people from falling. In the presentation emphasis is focused on the role of motor competence as a key determinant for compliance and adherence in regular physical activity. Basis focus is given on the conservation of the skeletal muscle mass in order to preserve and possibly to enhance the individual strength function and thereby to promote healthy ageing. The hypothesis is evaluated that improved motor competence is a crucial prerequisite for an adequate attitude to perform physical activity and to improve health status. In this context a study will be presented that has been conducted with the purpose to compare the effects of a typical resistance training and a sensory-motor training in elderly men (>60 years) on maximal bilateral isometric leg extension force (MIF) and maximal rate of force development (RFD).

Sixty healthy males (age 66.5±4.6 yrs; body-mass-index = 25.34±2.6kg/m<sup>2</sup>) have been assigned randomly to either a strength training (STG), sensory-motor training (PTG) or control group (CG), respectively. Both training groups conducted a twelve week training program with three training sessions a week. STG (n=20) performed a resistance strength training to the lower limb on the basis of 75% of

1RM. PTG (n=20) performed a sensory-motor training on wobble boards, on tilt boards and on uneven surfaces. In a weekly interval, intensity of the training regimen was progressively increased for both intervention groups. Before and after the training period isometric maximum voluntary contraction (MVC) and rate of force development (RFD) was determined from all participants. Onset of force was determined at 2% of each individual's MVC. Relative MVC and RFD values were determined at 30, 50 and 100ms relative to the onset of force. EMG from M. soleus and M. vastus medialis of the right leg was time normalized (AEMGsol; AEMGvm) in time intervals of 0-30, 0-50, 0-100ms as well as 100ms pre and post MVC.

The 12 week training period produced significantly enhanced MVC-values (STG: x = 27%; p<.01 and PTG: x = 13.1%; p<.01). RFDmax significantly increased in STG (x = 56%; p<.01) and in PTG (x = 25%; p<.01). Mean rate of force development 30, 50, 100ms after the onset of force production was significantly enhanced but less improved in the PTG (x = 55%; STG: 25% PTG). Normalized force values (MVC%) 20, 50 and 100ms after onset of muscular action were significantly higher in all time intervals after the training period (x = 29% STG; 8% PTG). These enhancements power corresponded well with enlarged neuromuscular activation amplitudes both for MVCmax as well as for the 20, 50 and 100ms values.

The present study demonstrates that sensory-motor training is quite as effective as normal strength training. The investigated group of elderly clearly demonstrated force and neuromuscular adaptations. The examined parameters illustrate that both sensory-motor training and heavy resistance training have a significant impact on MVC and RFD in the elderly. The gains in MVC and RFD are accompanied by considerable increases in the maximal voluntary neural activation of the leg extensor muscles (e.g. VM). The impact of sensory-motor training on MVC and RFD is remarkable for the fact that maximal and explosive force capacity was not specifically trained in the PTG. With regard to the prevention of falls and trips, it is of great functional interest that even in older subjects explosive force production capacity of the neuromuscular system remains trainable.

## Symposium

### Health Enhancing Physical Activity - Promoting Environments

S102H

#### S102H-1

#### **Sedentary behaviour in young people: Implications for promoting physical activity**

**Biddle Stuart**

Loughborough University, United Kingdom

*Keywords: health, sedentary behaviour, youth*

There is growing concern over the effects of sedentary lifestyles on the health of young people. Recent rapid increases in juvenile obesity have been attributed partly to television viewing and other sedentary behaviours which are thought to compete with physical activity. At the same time, travel statistics show marked declines in personal transportation and changing travel habits of children and youth. Surprisingly, little is known about health outcomes associated with sedentary behaviour. Project STIL (Sedentary Teenagers and Inactive Lifestyles) at Loughborough University is investigating 'what young people do'. Typically, measures of physical activity fail to capture the

diversity of physical inactivity and tell us nothing about what inactive people are actually doing. In this presentation, the following issues will be addressed in relation to young people:

1. Do key sedentary behaviours displace physical activity?
2. Are key sedentary behaviours obesogenic?
3. What sedentary behaviours do young people choose to do in their leisure time and are there clear secular trends?
4. What are the secular trends for children and youth in physical activity through personal transport?

Preliminary findings from Project STIL suggest that inactivity is more complex than we sometimes think. Indeed, measures of 'couch potato-ism' may be inappropriate as markers of inactivity. Implications for promoting physical activity will be highlighted.

S102H-2

**Environmental determinants of physical activity among women: Running as the behavioral model**

**Titze Sylvia**

Institute of Sport Science, Austria

*Keywords: running, environment*

Recent studies have explored the relationships of environmental factors identified by ecological models of health behaviour with physical activity. The purpose of this observational longitudinal study was to examine, prospectively, relationships between physical environmental factors and leisure-time running participation among middle-aged women.

At baseline, 822 (71% response rate) participants of a women's fun run and two years later 539 of them (66%) completed and returned a mail-out questionnaire. Regular running was defined as running at least twice a week for longer than 20 minutes per session and for at least the past 6 months. Bivariate comparisons and logistic regression analyses were used to assess relationships of environmental variables with running participation.

At baseline, 554 (67.6%) of the women reported that they ran regularly and 266 (32.4%) reported that they ran irregularly. Those women who perceived their running neighbourhood as attractive were 83% more likely to run regularly compared to those who perceived their neighbourhood less attractive. Women who needed =1min to reach the running area were 42% more likely to run regularly than women who reported >1min to reach the running area.

Those women who reported that they felt safe running during the day were 52% less likely to run regularly than those who reported to feel less safe to run during the day. Among initially irregular runners, none of the environmental variables were significant predictors for adopting regular running during the follow-up. The same was true for those who regressed from regular running to irregular running. In this sample of middle-aged participants in a women's fun run, physical environmental factors appeared to have marginal influence on adopting of and regressing from leisure-time running participation. In view of earlier observations these results suggest that environmental determinants may vary across different activity modes. Another explanation could be that irregularly (less than twice-a-week) running women already had running experiences at baseline and had already overcome physical environmental barriers such as finding a jogging trail in the neighbourhood. Hence, the environment may play a more important role in the adoption of regular running among totally sedentary women.

S102H-3

**Promoting lifestyle physical activities through environmental interventions: Recent experiences**

**Oja Pekka, Titze Sylvia**

University of Tampere, Finland

*Keywords: environment, promotion, intervention*

Recent epidemiological research provides new evidence base to explore the potential of environmental changes to promote health-enhancing physical activity among whole populations. Recent studies on promoting lifestyle physical activities through environmental interventions were reviewed. While increasing numbers of observational studies on the relationship between environmental factors and physical

activity have been published in recent years, only six intervention studies published since 1998 were identified.

Five studies targeted to increase walking up stairs instead of using an adjacent escalator or elevator, three studies used health-promoting poster signs, one compared posters and banners, and one used leaflets and simple incentives as prompts.

All five studies showed small but consistent increases in stair use. One randomised controlled trial targeted to promote work commuting walking and cycling, and showed increased walking but no change in cycling. Intervention studies targeting environmental changes to increase physical activity remain scarce and tend to be limited in their scope. The majority of published studies have targeted use of stairs instead of elevators or escalators. Their effectiveness on activity behaviour is consistently positive, but the effects are relatively small and short-term. There is the urgent need to establish a more solid evidence base for physical activity promotion through environmental changes.

S102H-4

**Environmental determinism: How space and community can create movement**

**Smith Andy**

York St John College, United Kingdom

*Keywords: community, environment, activity*

Whilst research into the Human Genome has lead to a greater understanding of the determinants of a number of diseases, it is unlikely to explain complex behaviours such as physical activity. To change people's lifestyles, we must understand how to change environments to enable healthy living.

This paper presents two case studies from York that show how space can be changed to enable communities to live more actively. Both case studies are based on the philosophy that environmental change should present people with decisions about how to behave rather than determining behaviour by restricting lifestyle options.

Case Study 1: How to change microenvironments. This case study demonstrates how York St John College (5000 students and 593 staff) has attempted to change its environment to promote healthy living. Data will be presented from strategic planning meetings and consultancy reports that show:

1. How within a £21 million capital investment in new buildings, it was possible to make cost effective decisions that provide opportunities for active commuting and living.
2. How through the implementation of Agenda 21 both green environmental outcomes and active living goals can be achieved.

Case Study 2: How to change macroenvironments. This macro study explores the issues involved in changing the environment of York (population 174,400 and 4,000,000 visitors per year) to promote active living. Data will be presented from policy documents and papers in the public domain that show:

1. That Cityscapes are shaped by a range of organisations and how these Institutions can be influenced by lobbying
2. How a City's Leisure Strategy can be based on health enhancing physical activity and how links can be made with life long learning.
3. How aspirations can be created within a City to become 'the most physically active City in the United Kingdom'.

From both case studies it can be concluded that:

1. We have inherited built environments that whilst initially shaped by geographical features (in the case of York the

confluences of the Ouse and Foss Rivers), have more recently been shaped by car 'driven' transport policies.

2. That through targeted individual and community action, even the biggest decisions can be influenced to provide more people, with more opportunities, to be more active, more often.

### S102H-5

#### Promoting physical activity through environmental change: theoretical basis and strategic directions

Owen Neville

The University of Queensland, Australia

*Keywords: physical activity, environment, population health*

Contemporary population-health policies emphasise promoting physical activity through environmental and policy changes. However, the relevant conceptual underpinnings are under-developed and there is as yet sparse evidence for the effectiveness of interventions based on 'environmental' frameworks. Research on physical activity behaviour relies on theoretical models that focus on intra-individual and proximal social attributes, using constructs such as attitudes, intentions, social norms, self-efficacy and stages of change. While ecological models identify the importance of such factors within multiple levels of influence on behaviour, they place more emphasis on the proximal physical environments in which particular behaviours take place ('behaviour settings').

The perceived aesthetic nature of the environment, accessibility of facilities and opportunities for activity all have been found to be associated with physical activity. Safety and the weather had less strong associations. In an Australian study, the specific behaviour of neighbourhood walking demonstrated stronger associations with environmental attributes than did measures of total walking or of total physical activity. Prospective research studies and intervention trials (where feasible) are needed to determine whether the cross-sectional associations of environmental attributes with physical activity that have so far been reported are likely to be cause-effect relationships.

Future physical activity campaigns might focus more explicitly on influencing perceptions of environmental contexts for activity. This will become increasingly relevant, as environmental and policy changes lead to more opportunities for physical activity and to community settings being more amenable to people being active (eg, more walking paths, cycle ways, attractive landscaping). Doing so could involve the reinforcement of positive perceptions of attributes of the environmental contexts for walking ('aesthetics' and 'convenience' in particular), and also changing negative perceptions. By focusing on specific behaviours (walking, in contrast to being generally more active), and on specific aspects of the environmental context of that behaviour, it may be possible to influence unique precursors of behavioural change in large groups of people. Innovative public-health strategies are needed in countries like Australia, where adults' physical activity levels have begun to show recent declines.

## Oral Session

### Biomechanics 2: Running Biomechanics

O102I

#### O102I-1

#### Energetic cost of running and efficiency of drop jump

Deiuri Emiliana, Telonio Alessandro, Morin Jean Benoit, Zameziati Karim, Antonutto Guglielmo, Belli Alain, Di Prampero Pietro

University of Udine, Italy

*Keywords: efficiency, stretch-shortening cycle, energy cost*

The capacity of contracted muscles to store elastic energy when forcibly lengthened and to reuse it in the subsequent shortening is generally defined as stretch-shortening cycle (SSC). Running and hopping are typical examples, in human locomotion, of the occurrence of SSC. Purpose of this study was to investigate whether the energetic cost of running (C) is related to the efficiency obtained during standardized SSC exercise with the aim of testing the hypothesis that a fraction of the individual differences observed in running economy is due to the different ability to store and re-use elastic energy. The experiments were performed on 9 male athletes (25.4 ± 4.7 years old) divided in two groups: 'explosive' (E) and 'non-explosive' (NE). The subjects performed a maximal oxygen uptake ramp test on a treadmill and repeated (every 5 sec) submaximal drop jumps on a specific 'sledge ergometer'. The energetic cost of running was calculated as the slope of the VO<sub>2</sub>-velocity curve between the walking-running transition and the anaerobic threshold speeds (treadmill), and the efficiency of the SSC exercise was calculated as the ratio between the total mechanical work performed (total work = |positive work| + |negative work|) and net oxygen

uptake during the 2 minutes of steady state (sledge ergometer).

A significant inverse correlation ( $p < 0.005$ ) was found between C and efficiency of drop jump (Spearman  $R = -0.85$ ). Significant difference ( $p < 0.001$ ) was found between the two groups regarding efficiency and C.

It can be concluded that the energetic cost of running is inversely related to the efficiency of SSC. In addition, sport type and specific training (plyometry), seems to split our population in two non overlapping groups: high efficiency- low energetic cost and low efficiency-high energetic cost. Furthermore, these findings may suggest that introducing plyometry in the training program of endurance athletes could improve performance, since a smaller C, i.e. a better running economy, for the same VO<sub>2</sub>, leads to a greater speed.

#### O102I-2

#### Stiffness regulation during simulated uphill and downhill running

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Laboratory of Physiology, GIPE2S, France

*Keywords: running, stiffness, work*

In running, it has been shown that both velocity and step frequency influence oxygen consumption and in some cases stiffness regulation of the legs. Uphill and downhill running conditions also influence oxygen consumption and muscle contraction mode, however, stiffness changes during such

conditions have never been studied. The aim of this study was to measure stiffness during simulated uphill and downhill running in order to further investigate stiffness regulation during human locomotion.

13 male runners performed on a treadmill ergometer 3 running bouts of 5 minutes at 3.33 m.s<sup>-1</sup> in normal (N) condition, pulled forward (PF) and backward (PB) with 5% body weight. Horizontal and vertical ground reaction forces were measured and step frequency (SF), mechanical work (W) and leg stiffness (K) were calculated for both negative (W- and K-) and positive (W+ and K+) work phase of contact. Metabolic energy consumption (Emeta) was assessed from oxygen consumption.

SF was 2.8 Hz ± 0.1 and was not different among the conditions. Compared to N condition (W- = W+ = 116 ± 15 J.step<sup>-1</sup>, Emeta = 2950 ± 325 J.step<sup>-1</sup>) W+ and Emeta were significantly (P<0.05) increased in PB (respectively +4.5% for W+ and +38.2% for Emeta) and decreased in PF (respectively -5.5% and -17.1%) conditions while opposite variations were found for W- (+6.0% in PF and -7.3% in PB). Compared to N condition (K- = K+ = 12kN.m<sup>-1</sup> in N) K was increased in the negative phase of PB (+11.4%) and in the positive phase of PF (+13.3%) but was not significantly modified in the positive phase of PB and in the negative phase of PF.

The fact that Emeta increased with W+ increase and W-decrease (PB) and vice versa (PF) was expected, because eccentric muscle work is less costly than concentric one. The main result of this study showed that when either W+ or W-decreased, the stiffness corresponding to those work phases maintained constant compared to N. It seems then, that rather than muscle force or muscle efficiency, the stiffness appears to be fixed at a nearly constant value when main mechanical constraints, presently muscle contraction mode, are modified during running. However, when W+ or W-decreased, the corresponding stiffness increased, because it was possibly necessary to generate higher muscle contraction during all phases of contact in order to maintain stiffness during critical phases.

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### O102I-3

#### A simple method for field assessment of stiffness during running

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**Keywords:** running, stiffness, field measurements

The spring-mass model has been widely used to describe the behaviour of the leg musculo-tendinous complex during running in humans (Blickhan, 1989; Farley and Gonzalez, 1996). These models define leg stiffness as the ratio of force over displacement of the "leg spring". However, those methods require force platform and/or kinematic measurements that are costly and few practical for field measurements. The aim of this study was to present a simple method for stiffness assessment during running, based on flight and contact time measurements.

4 male subjects ran at 10, 12, 14 and 16 km.h<sup>-1</sup> on an treadmill dynamometer allowing for each step the measurement of vertical ground reaction force and flight (tf) and contact (tc) times at 500 Hz (Belli et al, 2001). The reference vertical stiffness K<sub>vert</sub> was the slope of the vertical force-displacement relationship during contact (Farley and Gonzalez, 1996), the displacement being obtained by double

integration of the force signal over time. The reference leg stiffness was calculated as:  $K_{leg} = F_{max} / dl$ ,  $dl$  being the leg length change during contact. The vertical stiffness calculated with the presented method was:  $K_{vert} = mg / [m \cdot (tf + tc) / [tc^2 \cdot ((tf + tc) / \pi) - tc / 4]]$  with  $m$  the subject's body mass. This method, first developed for stiffness evaluation during hopping (Dalleau, 1998) is based on the modelisation of the ground reaction force during the contact phase by a sinus function. The calculated leg stiffness was  $K_{leg} = F_{max} / dl$  with  $F_{max} = mg \cdot \pi^2 / [2 \cdot ((tf + tc) + 1)]$  the modeled maximal force and  $dl$  the modeled leg length change during contact. Pearson's correlation test was used to assess the relationships between reference and modeled values for all the parameters. The absolute bias was calculated for each parameter value as:  $Bias = [(modeled - reference) / reference] \cdot 100$ .

The bias (respectively 2.6 and 10.9 %) and the significant correlations (P<0.01) between modeled and measured parameters of vertical and leg stiffness allow the validation of the presented method. Further, we obtained significant correlations between measured and modeled parameters of maximal force, vertical displacement of the CM and leg length change, that are the main components of the presented models.

In conclusion, this study proposed and validated a simple model based on flight and contact times for stiffness assessment during running, that could be useful in future field measurements.

### O102I-4

#### Effect of the muscle-tendon-unit's energy storage capacity on running economy

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**Keywords:** running economy, energy storage, muscle-tendon unit

The elasticity and so the energy storage capability of the muscle-tendon-unit is often reported as an important factor for motion economy. Nevertheless we did not find any study examining the influence of the energy storage capability of the muscle-tendon-unit on running economy. Therefore the purpose of this study was to examine the energy storage capacity of the tendon and aponeurosis of the muscles triceps surae and quadriceps on runners with different running economy.

Twenty three long distance runners run on a treadmill at three velocities for 15 minutes each. The oxygen consumption (V'O<sub>2</sub>) was measured using a spirometer. Further, the runners performed isometric maximal voluntary plantar flexion and knee extension contractions on a dynamometer. The kinematics of the leg was recorded using the vicon system to calculate the resultant moments at both studied joints. The proximal part of the distal aponeurosis of the gastrocnemius medialis and vastus lateralis during plantar flexion and knee extension respectively were visualised by ultrasound. Cluster analysis was used to divide the subjects into three groups according to their V'O<sub>2</sub> at all three velocities. The differences between the groups were determined using one-way analysis of variance.

At all examined velocities the three groups showed statistically significant (p<0.05) differences in V'O<sub>2</sub>. The runners of group 1 (n=7) demonstrated the best running economy followed by group 2 (n=10) and group 3 (n=6). No differences in maximal strain and elongation of the triceps surae between groups were found. The maximal moment and

force of the muscle triceps surae were greater for group 1. So the maximal energy storage capacity of the triceps surae tendon and aponeurosis was greater in the most efficient group. Further, group 1 demonstrated a greater maximal strain and elongation at the quadriceps tendon and aponeurosis but no statistically significant ( $p < 0.05$ ) differences in maximal moment and force of the quadriceps muscle. The maximal energy storage capacity of the quadriceps tendon and aponeurosis was again greater for group 1.

The most efficient runners exhibit a higher maximal energy storage capacity in both triceps surae and quadriceps tendon and aponeurosis. At the triceps surae it is due to a higher contractile capability of the muscle tendon unit and in quadriceps due to a higher elongation of the series elastic element of the muscle tendon unit.

#### O102I-5

### An attempt to define different stride patterns in treadmill running

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**Keywords:** *biomechanics, technique, treadmill running*

The aim of this experiment was to determine biomechanical characteristics of two different stride patterns in level running on treadmill for one subject. In trail technique of running the subject drags the supporting leg under the body while in bouncing technique of running the subject rebounds the body from the ground in vertical direction and left the treadmill to move supporting leg backward.

One male subject ran in trail and bouncing technique on the treadmill for 16 min continuously. The first four minutes he ran in bouncing technique at 8 km/h, next four minutes he ran in trail technique at 8 km/h, the third four minutes he ran in bouncing technique at 10 km/h, and the last four minutes in trail technique at 10 km/h. The surface EMG signals of different leg muscles were recorded, the ankle, knee and hip angles, the contact and flight times and VO<sub>2</sub> were measured. The results showed that trail running technique and bouncing running technique are significantly different in most parameters analyzed in this experiment. The exceptions are the hip angle in the moment of touch-down, the IEMG of the m. vastus lateralis in reflex mediated phase, and the average EMG of the m. rectus femoris in voluntary control phase. Comparison between the trail technique of running and bouncing technique of running showed that in trail technique more stress was given to the last half of the contact phase while in bouncing technique more stress was given to the preactivation and the first part of the contact phase when the subject prepared the body for the touchdown. The VO<sub>2</sub> was expected to be smaller in bouncing technique due to more stretch-shortening cycle behavior.

It can be concluded that inter-muscular co-ordination is different in analyzed running techniques. This is important for individual runners to recognize his technique since it is speculated that differences in techniques do not only reflect the muscle activation patterns but are also dependent on mechanical characteristics of the involved muscles. Accordingly, changing or improving running technique should therefore involve changes at muscular level as well.

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*Guidetti L et al (1996). J Electromy Kinesiol 6: 37-48*

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#### O102I-6

### Propagation of the waves generated by heel strike during running

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**Keywords:** *running, propagation, shock waves*

During running, heel impacts on ground generate vertical forces of about 2 to 3 times the body weight. As a consequence shock waves are transmitted to the lower limbs; to a whole body and could be measured, by means of accelerometers, at shank and trunk levels. However, to the best of our knowledge the propagation characteristics of these waves are not well documented in literature. The aim of this study was then to measure and to model shock waves propagation during running.

10 healthy and physically active women with a body mass (bm) of  $59.5 \pm 6.8$  kg, ( $163.6 \pm 5.6$  cm,  $21.8 \pm 1.5$  yrs), ran on a treadmill ergometer. After a warm-up of 10 min, subjects had to run during 30 seconds at 9 km/h. Vertical ground reaction forces (Fv) and trunk accelerations (Ab) were respectively measured by the treadmill ergometer and with an accelerometer located on the skin covering the spine at eighth dorsal vertebrae. Vertical force (Fv) and body acceleration were sampled at 1000 Hz during the last fifteen seconds of each bout. About 40 consecutive steps were then filtered (30 Hz low pass filter) and analysed. Vertical acceleration (Acm) of centre of mass was calculated as:  $Acm = Fv/bm - 9.81$ . Time delay (after initial foot contact determined by an Fv threshold of 50 N) and amplitude of passive peak and propulsive peak of both Acm and Ab were measured. A T-test was used to compare the delay and amplitude between Acm and Ab. Amplitude and delay values of passive peak were higher in Ab than in Acm (respectively  $31 \pm 2$  ms vs  $47 \pm 8$  ms for delays and  $4.5 \pm 1.4$  m/s<sup>2</sup> vs  $18.1 \pm 5.8$  m/s<sup>2</sup> for amplitudes).

No significant differences were observed concerning the propulsive peak (about  $127 \pm 11$  ms and  $11 \pm 1$  m/s<sup>2</sup> for both Acm and Ab). Amplitude values of acceleration measures from Fv and at trunk level were in agreement with the literature. Differences of amplitude and delays between passive peaks at CM and trunk level are probably respectively due to the damping of hill lower limbs and trunk and to the skin elasticity and movements at trunk level. In addition, no differences were observed in characteristics of active peaks. It could be assumed that no significant damping occurs between ground and trunk during the propulsive phase. This fact further supports the validity of a simple spring mass model for modelling the biomechanics and energetics of running.

#### O102I-7

### Constraints on human turning behavior

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**Keywords:** *turning preference, rotation*

Due to a differential development of the left and right brain hemispheres, humans are featured by a functional asymmetry. Turning preference is one of the expressions of this laterality. The first aim of this study was to register the intrinsically preferred turning direction in humans. The second aim was to investigate to what extent external constraints affect the systematic rotation in one preferred direction.

107 male (n = 54) and female (n = 53) PE students (18-25 yrs.) ran back and forth between two lines 9.5 m apart during 60 seconds at low speed. They made 180° turns at the end of each length, and 360° turns in the middle of the trajectory. From two 25 Hz videocameras, the Rotation Index (RI) was calculated as the percentage of turns made to the left by each subject.

In a second session, time and position constraints were imposed. Participants from one line to another. They started with their back towards the running direction in three different starting positions: 1) feet together (BT), 2) left foot in front (BL), and 3) right foot in front (BR).

46.7% were extremely left turners (EL: RI 97%), 26.2% were left turners (L: RI 73%), 6.5% were neutrals (N: RI 49%), 12.2% were right turners (R: RI 29%), and 8.4% extremely right turners (ER: RI 4%). On average, 70% of all turns was made leftwards. The reliability of this baseline preference was high (ICC = 0.87). In the BT condition, the number of

turns made to the left was not different from the baseline condition: 61.5 % (p > .05). With the left foot in front (BL), participants almost exclusively turned to the right (only 8.5% leftward turns), while the opposite occurred with the right foot in front (93.5 % leftward turns).

Our data show that in unconstrained conditions, humans have a strong and stable preference for turning leftwards, while other studies have shown the opposite (Mead & Hampson, 1996). However, having one foot in front makes it easier to turn to the contralateral side from a mechanical point of view, even if that side is not the preferred turning direction. As a general conclusion, humans do have an intrinsically preferred turning direction, which is however easily suppressed by externally imposed constraints.

Mead LA, Hampson E (1996). *Beh Brain Research* 78, 73-79

## Oral Session

### Sports Medicine

O102J

O102J-1

#### Energy balance and metabolism in immobilisation: effects on the anabolic and catabolic state

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**Keywords:** immobilisation, hormones, metabolism

Immobilisation is often a necessary component of the intensive medical care of trauma victims and patients with severe illness. Nevertheless, inactivity causes profound deleterious adaptations of normal physical processes such as energy balance and metabolism. One possible explanation of these unfavourable changes is a metabolic or emotional stress response with stimulation of the hypothalamic-pituitary-adrenal axis and side effects on the anabolic system. To further investigate these adaptations a head down bed rest model is very useful.

We investigated nine young and healthy men under two different, balanced normocaloric conditions: under (1) normal physical activity (NPA) and (2) under condition of microgravity (HDT). The study phases were split in 9 days of pre-intervention with normal physical activity (L-8 - L-1), 14 days of intervention (I0 - I13) and a 4 days post-intervention phase. Urinary excretion rates of Testosterone (T), Androsterone (A), Etiocholanolone (E), 5-alpha-Androstanediol (Adiol), 5-beta-Androstanediol (Bdiol) as well as 11-alpha-Hydroxy-Etiocholanolone (OH-E) and Tetrahydrocortisol (TH-F) were measured in 8 hrs urinary samples (11pm - 7am) of day L-6 and days I8 and I11.

The excretion rates of hormones in 8 hrs urinary samples varied widely from day to day and among individuals. Excretion rates of the two testosterone metabolites A and E, originating mainly from adrenal testosterone, increased significantly from day L-6 to day I11 in both conditions (HDT and NPA), while testosterone and Bdiol excretion rates tended to be higher in I11. Adiol excretion rates were unchanged during this period. For all single metabolites of the anabolic system, excretion rates did not differ significantly.

Catabolic steroid metabolite excretion rates of OH-E and TH-F also increased significantly from day L-6 to day I11 in both conditions. Changes of the OH-E excretion rate as compared

to L-6 level tended to be higher in HDT than in NPA. Anabolic (p=0,015) and catabolic (p=0,043) steroid synthesis is activated under both conditions.

This might be due to an activation of the hypothalamo-pituitary-adrenal axis with stimulation of ACTH secretion that regulates both the glucocorticoid and the adrenal anabolic steroid synthesis. However, our data further indicates that HDT condition has a stronger effect on the activation of especially the catabolic system. This is perhaps due to the increased stress that seems to be associated with the bed rest condition.

O102J-2

#### Changes in explosive muscle strength due to heavy resistance strength training with creatine, protein or carbohydrate supplementation

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**Keywords:** strength, creatine, rate of force development

Dietary supplementation can enhance the effect of strength training. Creatine supplementation has shown to increase body mass and some aspects of performance and strength. The effect on explosive muscle strength is less clear. The aim of this study was to investigate changes in maximal isometric strength (MVC) and contractile Rate of Force Development (RFD) on the quadriceps and hamstring muscles, in response to heavy resistance strength training (HRT) with creatine, protein or carbohydrate supplementation.

26 untrained male subjects completed 16 weeks of HRT, which focused on knee extension and flexion exercises.

In a double-blind fashion subjects were randomly assigned to either a creatine (n=10), protein (n=8) or carbohydrate (n=8) group. Knee extension and flexion MVC and RFD were measured before and after the HRT program (Aagaard 2002). RFD was measured as peak RFD and at time points of 50-100-200ms from onset of contraction.

For the quadriceps muscle all three groups significantly increased MVC and RFD at 200ms post training and the

carbohydrate group increased RFD at 100ms for the quadriceps.

For the knee flexion all three groups increased these two variables with the exception of MVC in the carbohydrate group ( $P < 0.07$ ) and knee flexion RFD at 200ms in the protein group. However, the creatine group was the only group experiencing significant improvements in Peak RFD, RFD at 50ms and RFD at 100ms in the hamstrings.

The increase in strength and RFD demonstrates an increased ability to develop explosive muscle strength after 16 weeks of resistance training. Out of the total 10 variables tested the creatine improved 7 while the protein and carbohydrate only increased 3 and 4 respectively. Only the creatine supplementation increased all 5 parameters on the hamstring muscles compared with only 1 each in the other groups. Creatine supplementation with HRT seems to increase hamstring muscle explosive strength more than traditional protein and carbohydrate dietary supplements.

Aagaard et al (2002) *Journal of Applied Physiology*; 93(4):1318-26.

### O102J-3

#### Exercise consultation increased physical activity and improved both glycaemic control and cardiovascular risk factors in people with Type 2 diabetes

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**Keywords:** type II diabetes, exercise consultation, risk factors

The benefits of physical activity for management of Type 2 diabetes are well documented. Around 80 percent of people with Type 2 diabetes do not do enough physical activity to achieve these benefits. Effective methods for promoting physical activity in this population are required.

70 inactive people with Type 2 diabetes were given standard exercise information and randomised to receive an exercise consultation intervention ( $n=35$ ) or not ( $n=35$ ). Exercise consultation, based on the transtheoretical model, combines motivational theory and cognitive behavioural strategies into an individualised intervention to promote and maintain physical activity. Exercise consultations were delivered at baseline and 6 months with support phone calls given 1 and 3 months after each consultation. Changes from baseline at 6 and 12 months were assessed in physical activity (7-day recall & accelerometer), glycaemic control (HbA1c & medication) and cardiovascular risk factors (body mass index, blood pressure & lipid profile).

Between group differences were recorded in physical activity (recall and accelerometer) at 6 and 12 months ( $p < 0.01$ ). The experimental group increased physical activity (recall and accelerometer) from baseline to 6 months ( $p < 0.01$ ), with no decrease from 6 to 12 months ( $p > 0.05$ ). The control group decreased accelerometer counts/wk from baseline to 12 months ( $p = 0.03$ ) and recorded no change on the recall ( $p > 0.05$ ). Between group differences were recorded in HbA-1c at 6 and 12 months ( $p < 0.01$ ). The experimental group decrease (improved) HbA-1c (nondiabetic range 4.5-6.0%) from 8.31-8.05% and 8.04% from baseline to 6 and 12 months respectively. The control group increased (deterioration) in HbA-1c from 8.85%-9.00% and 9.19% from baseline to 6 and 12 months respectively. No significant between group changes in diabetes therapy were recorded. There was a between group difference for the change in systolic blood pressure from baseline to 6 months ( $p = 0.02$ ) and in total cholesterol from baseline to 12 months ( $p = 0.03$ ).

Systolic blood pressure decreased from 149.1 to 142.8 mmHg in the experimental group and increased from 143.0 to 148.0 mmHg in the control group. Total cholesterol decreased from 4.87 to 4.55 mmol/L in the experimental group and increased from 4.74 to 4.78 mmol/L in the control group.

Exercise consultation increased physical activity and improved glycaemic control and cardiovascular risk factors in people with Type 2 diabetes.

### O102J-4

#### Cardiac parasympathetic modulation during pharmacological blockade in overtrained athletes: Experimental prospective study

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**Keywords:** blood pressure, overtraining, pharmacological blocking

Heart rate and blood pressure variability (HRV, BPV) have been used as an indicator of cardiac and vascular autonomic modulation. Overtraining syndrome is a complex process, where athletes do not have enough physical and mental recovery time. The purpose of this study is to explore changes in autonomic cardiac and vascular function during an experimental 6-9 -week heavy training period using atropine, a parasympathetic receptors' blocking agent.

Twelve endurance athletes ( $26 \pm 4.4$  yr) in an experimental training group (ETG) and 9 endurance athletes ( $25 \pm 4$  yr) in a control group (CG) were examined. ETG athletes increased their training volume during the training period from the baseline (base, 8.7 h/week) to the end by 58%, and volume of intensive training (from 1.0 h/week) by 63%. CG did not change their training volume during the follow-up. Four subjects from ETG and one subject from CG were diagnosed as overtrained. At the base and at the end, HR and BP with controlled breathing frequency of 0.2 Hz were measured during graded atropinization at supine rest. After 2 min, four i.v. boluses of atropine sulphate (0.01 mg/kg) were injected at 2-min intervals. Calculated parameters were mean and standard deviation (SD) of R-R intervals (RRI), and of systolic (SAP) and diastolic blood pressure (DAP), the square root of the mean of the sum of the squares of differences between adjacent RRIs (RMSSD), and fast deviation (SD1) and slow deviation (SD2) of RRIs.

Mean SAP and DAP increased significantly ( $p < 0.05$ ) during the atropinization. After the second and third dose, SAP (mean (SD); 120.2 (4.6) mmHg vs. 131.8 (4.8) mmHg and 122.0 (4.9) mmHg vs. 135.3 (4.6) mmHg) was significantly ( $p < 0.05$ ) lower at the base than at the end. In CG after the third dose, SD of SAP (5.1 (1.7) mmHg vs. 3.1 (0.7) mmHg) and SD of DAP (2.8 (0.9) mmHg vs.  $1.9 \pm 0.4$  mmHg) were significantly ( $p < 0.05$ ) higher at the base than at the end. HR increased and HRV decreased significantly during the atropinization ( $p < 0.05$ ). Significant training induced changes in HR and HRV at rest and during atropinization were not found.

The main findings of the study were the BP changes during the training period without significant changes in HR. BP, especially SAP, increased more sensitively during the atropinization after the heavy training than before that i.e. heavy training seemed to effect on vascular autonomic modulation more sensitively than to the cardiac one.

Uusitalo ALT (2001). *The physician and sportsmedicine* 29 (5): 35-50

Uusitalo ALT et al (1996). *Clin Physiol* 16: 575-588



## O102J-5

**Effects of interval training on the metabolic recovery from severe exercise****Bishop David, Edge Johann, Goodman Carmel**

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**Keywords:** *phosphocreatine resynthesis, lactate removal, pH*

Oxidation is a major pathway of metabolism for lactate and is essential for PCr resynthesis during the recovery from exercise. This suggests that individuals with an improved aerobic fitness should better be able to remove lactate and to resynthesise PCr following exercise. Indeed, cross-sectional research and one training study support this hypothesis following low-intensity exercise. However, it is not known if endurance training has a similar effect following more intense exercise where there is a significant decrease in muscle pH. The purpose of this study was to investigate the effects of interval training on metabolic recovery following severe exercise.

Ten active females (mean  $\pm$  SD, age:  $19.6 \pm 2.6$  y, mass:  $58.4 \pm 4.5$  kg) trained 3 x/wk for 8 wks. Training consisted of 4 - 12 x 2-min intervals (1-min rest) at 140 - 180% of lactate threshold (LT). Pre and post testing, subjects performed a graded exercise test followed ~ 48 h later by a time-to-fatigue (tff) cycle test, performed at the individuals peak VO<sub>2</sub> power output ( $173 \pm 25$  W). Muscle biopsies (vastus lateralis) were taken immediately before, 10 s and 180 s after the tff cycle test to determine [ATP], [PCr], muscle lactate ([La-]) and hydrogen ion accumulation ([H<sup>+</sup>]).

The 8-wk training program resulted in a significant increase (~20%) in both peak VO<sub>2</sub> ( $38.8 \pm 6.4$  v  $46.3 \pm 6.7$  mL/kg/min;  $P < 0.05$ ) and LT ( $114.6 \pm 16.9$  v  $138.2 \pm 20.4$  W;  $P < 0.05$ ). However, despite these improvements in aerobic fitness, there were no significant differences between pre and post training values of [La-], [PCr], [ATP] or [H<sup>+</sup>]. There were also no significant differences between pre- and post-training values for post-exercise rate of change in any of these metabolites. Although training resulted in a significant increase in tff ( $461 \pm 130$  v  $1026 \pm 310$  s;  $P < 0.05$ ), there was no significant difference in immediate post-exercise muscle pH (pHi;  $6.88 \pm 0.10$  v  $6.87 \pm 0.06$ ;  $P > 0.05$ ).

Therefore, despite a 20% increase in aerobic fitness, interval training did not improve the immediate metabolic recovery from exercise. While this is in contrast with previous studies that have utilised low-intensity exercise, it may be that endurance training does not enhance immediate metabolic recovery when there is a significant decrease in pHi. It is possible that a low pHi inhibits the oxidative capacity of skeletal muscle to synthesise ATP and therefore to resynthesise PCr and to oxidise La-.

## O102J-6

**Influence of cycling cadence strategy on metabolic parameters and running time to fatigue in triathletes****Vercruyssen Fabrice, Suriano Robert, Bishop David, Hausswirth Christophe, Brisswalter Jeanick**

University of Toulon-Var, France

**Keywords:** *triathlon, cycling cadence, running adaptation*

During field-based testing bouts, Gottschall and Palmer (2002) showed an improvement in running performance after a cycle exercise completed at 109 rpm compared to 90 and 71 rpm whereas Bernard et al. (in press) indicated no effect of extreme cadences (60-100 rpm) on a 3000-m run performance. However, Vercruyssen et al. (2002) suggested

that cycling at low cadences (73 rpm) was beneficial in term of Vo<sub>2</sub> after 30 min. The aim of this study was to examine, in a laboratory setting, the effect of different cadence strategies on subsequent running performance.

Eight triathletes performed two incremental tests to determine maximal oxygen uptake (Vo<sub>2</sub>max) and the lactate threshold (LT) for cycling and running and three C-R sessions. Subjects performed the cycle bout of C-R (90 % of LT) either 1) at the freely chosen cadence (FCC, 94 rpm) during 30-min, 2) at FCC during the first 20 min and at FCC-20 % during the last 10 min (FCC[C-20%], 74 rpm), or 3) at FCC during the first 20 min and at FCC + 20 % during the last 10 min (FCC[C+20%], 109 rpm). Each cycling bout was immediately followed by a run time to exhaustion (RTE, 85% of maximal speed).

Mean values for oxygen uptake (Vo<sub>2</sub>), ventilation (VE), blood lactate concentrations ([La-]) and heart rate (HR) were significantly reduced after 30 min of FCC[C-20%] compared to FCC[C+20%]. No significant differences were observed between FCC and FCC[C-20%]. However, a significant increase in RTE was observed after FCC[C-20%] compared to FCC and FCC[C+20%].

The selection of low cadences (74 rpm) before the C-R transition is associated with a reduction in metabolic load during cycling and an improvement in RTE. This pedalling strategy may reduce the development of fatigue process classically reported during the final kilometres of cycling and could improve the running performance within the constraints of triathlon racing.

*Bernard T et al (in press). Br J Sports Med**Gottschall JS, Palmer BM (2002). Med Sci Sports Ex 34 (9), 1518-1522**Vercruyssen F et al (2002). Med Sci Sports Ex 34 (3), 530-536*

## O102J-7

**Plasma amino acids (AA) levels before and after an ultra-endurance event****Smith Lucille, De Jager Andriette, Semple Stuart, Neveling Nevel, McKune Andrew, Peters Edith, Eisenburg Ben**

Technikon Pretoria, South Africa

**Keywords:** *protein, amino acid, ultra-endurance*

During an ultra-endurance event, AA may be recruited to provide substrate for gluconeogenesis, anaplerosis of Krebs cycle intermediates, as well as for a new synthesis of proteins. The purpose of this study was to determine whether pre-race plasma AA (20) were within normal ranges, and to assess alterations in post-race values.

11 experienced volunteers (6 males, 5 females), had blood drawn at the following times: 24 h prior to projected finishing time, immediately after (IPE), 3 h, 24 h, and 72 h after an ultra-marathon. Plasma was stored at -80°C and analyzed using HPLC. Results were analyzed using a one-way ANOVA ( $p < .05$ ).

All values were compared to pre-race values. The following values were significantly decreased IPE: Asn (32%), Gln (21%), His (16%), Ala (34%), Leu (48%). The following AA were decreased IPE and at 3h respectively: Ser (28% and 21%), Gly (21%, 24%), Thr (44%, 26%), Arg (36%, 20%), Pro (66%, 45%), Val (40%, 27%), Met (25%, 19%), Ile (51%, 34%), Leu (48%, 22%). Phe increased IPE and at 3 h (20%, 29%). Gly was the only AA that remained decreased at 24 h (15%).

In experienced ultra-distance runners, most pre-race AA were at the lower end of normal range. IPE, 15 of the 20 AA were

significantly altered. Nine remained altered at 3 h. All AA were within baseline ranges by 72 h. Although no information is available concerning diet or amino acid supplementation, based on these results it appears that experienced ultra-distance runners are able to regulate amino acid metabolism before and by 72 h after an ultra-marathon.

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## Poster Session

## Training and Testing 1

P10M

## P10M-01

**The influence of the difference between the race performance and the time trial performance on the race performance in triathlon running**

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*Keywords: triathlon, aerobic capacity, race performance*

In triathlon, running is the final event and triathletes have to do running with fatigue of swimming and cycling. It is expected that the race time (RT) of running in triathlon becomes late as compared with the trial time (TT) of independent running. In this study, we used the rate of RT to TT (%Change of time: %Time) as an index of a decline of time. If %Time is different in each athlete, %Time may affect the triathlon race performance. But there is no study that investigates the difference between race time and trial time. Therefore the purpose of this study was to investigate the relationships between RT, TT and %Time. We also examined the relationships between %Time and the aerobic capacity that is related to the race time.

Thirteen triathletes (age 20.8±1.8 years, height 172±6 cm and body weight 63±6 kg) participated in this study. The 10km running time was measured in triathlon race and independent trial. As an index of aerobic capacity, ventilatory threshold (VT) and maximal oxygen uptake (VO2max) were measured during an incremental running test.

There was significant difference between RT and TT. RT was significantly correlated to not only TT but also %Time. But no correlation was found between TT and %Time. Furthermore, VO2max and VO2@VT were not correlated to %Time while they were significantly correlated to RT and TT.

These results suggest that it is important for triathletes to minimize the difference between race time and trial time as well as to develop the running ability itself. Moreover, triathletes have to do specific training for minimizing the difference between race time and trial time, because the difference may be affected by some factors other than VO2max or VT.

## P10M-02

**Identification and reliability of predictors for talent selection of young female handball athletes**

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*Keywords: handball, testing, talent*

Talent identification in German handball relies on subjective expert judgement by the national coaches. Primarily players' technical and tactical abilities are observed. In borderline cases sometimes motor tests that are specialized to handball players are considered. The aim is to identify and test reliability of predictors for talent selections.

Young female athletes were assessed by the national coaches at two times within six months. During these try-outs they were video-taped playing handball and their motor

abilities were examined with general and handball-specific tests.

The stepwise forward Likelihood-quotient method for logistic regressions identified as primary predictor number of actions ( $c^2(1) = 11.37$ ,  $p = .01$ ,  $R^2 = .47$ ), which allowed a correct classification of 86 % of the cases. As the second step motor test handball long throw improved the explained variance (number of actions:  $c^2(1) = 11.20$ ,  $p = .01$  plus handball long throw:  $c^2(1) = 3.16$ ,  $p = .08$ ,  $R^2 = .55$ ), but decreased correct classification to 84 %. Both classifications are above a-priori-classification of 74 %. In measurement phase 2 stepwise forward logistic regression identified as the primary predictor motor test ball bouncing on a longbank ( $c^2(1) = 6.96$ ,  $p < .01$ ,  $R^2 = .55$ ) allowing a correct classification of 83,9 %. In the second step rating of the second expert "on how they did it" was identified as the additional predictor ( $c^2(1) = 5.89$ ,  $p = .01$  /  $c^2(1) = 3.67$ ,  $p = .06$ ,  $R^2 = .70$ ) improving correct classification up to 93.5 % (by chance = 77.4 %).

The results indicate no reliability of the predictors identified by the logistic regression. So the conclusion of this study might be that the attempt to quantify internal predictors failed due to a number of problems. First the low objectivity of the experts. Second the non-constant nomination by the national coaches, who selected only 9 out of 12 players twice. Problems with the first nomination become apparent by comparing the national and five regional coaches with a very low K-coefficient  $K = .12$  ( $p = .20$ ). A different talent selection approach should be considered. Additional factors like motivation show a significant difference ( $t(61) = 1.64$ ,  $p = .10$ ,  $h^2 = .04$ ) within this sample.

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## P10M-03

**The relative age effect in senior soccer: A shift since 1997**

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*Keywords: talent selection, birth-date distribution, selection year*

Consistent asymmetries in birth-date distribution have been revealed in both senior professional players and youth sport categories. These skewed birth-date distributions have been interpreted as evidence for a systematic discrimination against players born shortly before the cut-off date. This investigation examines the effect of a shift in the start of the selection period (from August to January) in 1997 throughout senior soccer players.

2138 senior soccer players selected over the last four competitive years by Belgian second and third division teams were incorporated. Birth-date months were considered for two age groups: group 1 contained players born before or in 1980 ( $n=1640$ ); group 2 players born after 1980 ( $n=498$ ). Differences between the observed and expected (Belgian population) birth-date distributions were assessed by using a

Kolmogorov-Smirnov test. Subsequent regression analyses examined the relationship between the number of soccer players per age group and the corresponding month of birth. 'Month 1' is defined as the start (group 1 = Aug; group 2 = Jan) while 'month 12' (group 1 = Jul; group 2 = Dec) is the end of the selection year.

Kolmogorov-Smirnov tests exposed different distributions across the 12 months.

Regression analyses revealed clear relationships between month of birth and number of soccer players for group 1 (adj.  $R^2=.72$ ,  $p<0.001$ ) and group 2 (adj.  $R^2=.40$ ,  $p<0.001$ ). For group 1, the number of births is high in August and September (beginning of the selection year) and decreases progressively afterwards. The spreading in births of the youngest group of players shows a bimodal curve. An extreme peak in August interrupts the gradual decrease from the beginning (January) to the end (December) of the new selection year.

Results also clearly indicate a shift in month of birth distribution. The first quarter of the selection year still 'generates' more players (group 1: 28.8%; group 2: 31.5%) whereas births remain least frequent in the last three months (group 1: 19.9%; group 2: 19.5%).

In accordance with previous studies, birth-date distributions of national senior soccer players are significantly biased towards a higher number of births during the early part of the selection year. These data provide evidence that a shift in birth-date distribution of senior national soccer players has occurred since the change of the cut-off date in 1997.

#### P10M-04

### Comparison of a 10 weeks resistance strength training program on prepubescent girls and boys

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*Keywords: strength training*

The purpose of this study was to investigate the effects of a 10 weeks resistance training program on the development of the maximal isometric strength, muscle thickness, contracted brachial perimeters, relaxed brachial perimeters, push-ups, pull-ups and throwing a roller-skate hockey ball in prepubescent girls and boys.

The sample was divided into two different groups, the experimental group (EG,  $n=17$ ) and the control one (CG,  $n=17$ ) and comprises 20 girls ( $9.44 \pm 0.28$  years) and 15 boys ( $9.34 \pm 0.30$  years) in the maturation stage I according to Tanner's Scale. The EG group was submitted to a training program with callisthenic exercises three times a week (90 minutes each session) during 10 weeks. The program consisted of training push-ups, modified pull-ups and 2 exercises with elastics (elbows flexion and extension and extension of the arms above the head) until exhaustion. The training volume was gradually adapted from 3 series between the 1st and 3rd week to 4 series between the 4th and 6th week and to 5 series between 7th and 10th week.

The results suggested that prepubescent children can increase strength following a strength training program that includes callisthenic exercises. This training program does not seem to have a significant effect in the development of the FIMV. The strength gains were not followed by an increase of muscle mass. In this study we only evaluated the neuromuscular factors (EMG) in FIMV and the alterations of the neuromuscular activations were not significant. It seems that the elements underlying the increase and strength gains

can be related to the increase of the coordination of the movement. The coordination seems to be an element that highly contributes to the increase of strength for more complex exercises.

#### P10M-05

### Effects of strength training and diet on health markers in aging women

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*Keywords: strength training, aging, nutrition*

This study examined effects of strength training (ST) and diet on health markers.

27 middle-aged women (MW:  $52.9 \pm 2.3$  yrs, BMI  $24.8 \pm 3.2$  kg/m<sup>2</sup>, body fat%  $28.2 \pm 5.4$ , 1RM leg press  $107.7 \pm 19.7$  kg) and 24 older women (OW:  $64.6 \pm 4.5$  yrs, BMI  $26.1 \pm 3.2$  kg/m<sup>2</sup>, fat%  $30.4 \pm 5.9$ , 1RM leg press  $96.5 \pm 23.2$  kg) were randomly divided in two groups: 1) ST+nutritional counseling (NC), and 2) ST+no-nutritional counseling (NNC). Supervised progressive ST was performed two times a week for 21 weeks. NC was handled at week 0 and 10,5 in an attempt to guarantee sufficient energy and protein intake, proper balance of nutrients, and healthy aspects of diet. Dietary intake (DI) was recorded by 4 days dietary diaries and health markers (resting blood pressure, resting heart rate, fasting blood health markers) using standard analyses.

At week 21 1RM leg press had increased significantly ( $p<0.001$ ) in all groups by 26-29%. There were no differences in DI between the MW groups at week 0, but after NC energy intake was higher in ST+NC group at week 2. Some differences were observed between the OW groups in DI at week 0, but after NC DI became similar already at week 2.

After ST resting systolic blood pressure had decreased in both MW groups and resting diastolic blood pressure in MW ST+NC only. No significant changes were noticed in resting heart rate. Fasting blood glucose level had decreased in MW and OW ST+NC. Erythrocyte sedimentation rate had increased significantly in all groups. Blood haemoglobin had decreased in OW and MW ST+NNC, and packed cell volume in OW. Serum total cholesterol had decreased in OW, serum high-density lipoprotein cholesterol had increased in all groups, and serum low-density lipoprotein cholesterol had decreased in OW and MW ST+NNC. No changes were observed in serum triacylglycerols.

Strength training produced favorable changes in resting blood pressure, fasting blood glucose concentration and serum lipids. Nutritional counseling further contributed to health markers of resting diastolic blood pressure, resting blood haemoglobin and serum triacylglycerols in middle-aged women, and fasting blood glucose in older women. The data showed that strength training alone favourably affected health markers, and that nutritional counseling even contributed to positive changes of selected health aspects. Further research is needed to study whether nutritional counseling given more frequently would lead to more potent positive influences on health markers in both men and women.

## P10M-06

**Contribution of particular components to the overall swim performance in 200m individual medley****Vucetic Vlatko, Petkovic Vlado, Leko Goran**

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*Keywords: swimming, 200m medley*

The share of different components in the final result in 200m medley race was analyzed, aiming to acquire relevant information for detection and comparison of the parameters. Using the linear regression analysis the influence of time-space parameters and extracted latent dimensions on the final result was analyzed.

The analysis was conducted on a sample of 112 top-level swimmers, aged 17-30, semifinalists and finalists in the 200m medley races. 25 partial indicators of the situation-related efficiency and their influence on result (RT) and classification (RANG) were monitored.

The correlation coefficients of monitored parameters - speed and stroke frequency in the backstroke, breaststroke and front crawl with both of the criteria (RT and RANG) proved statistically significant correlations. The parameters associated with the backstroke and breaststroke sections are standing out when it comes to correlations with the final result ( $p < 0.01$ ). The regression analysis is highlighting five variables: 125BR ( $\beta = -0.22$ ); TSBRCR ( $\beta = -0.20$ ); TSBABR, 150BR and 100BA ( $\beta = -0.19$ ). By means of factor analysis the factor defined as energetic-tactical readiness (125BR, 150BR, 175CR, 200CR and FSL5M) and the factor defined as technical economy (S15M, 25FY, 50FY, 75BA, 100BA TSYBA and TSBABR) were extracted, and regression analysis is highlighting the importance of the first factor ( $\beta F1 = -0.76$ ,  $p < 0.00$ ), with the less influence of the other ( $\beta F2 = -0.59$ ,  $p < 0.00$ ). The importance of the first factor is manifested in the classification prediction ( $\beta F1 = 0.34$ ,  $p < 0.00$ ). The overall performance depends on the integral functioning of the mutually conditioned factors. The key race segment is swimming speed of the second backstroke section, and the complete breaststroke section with its associated turns where the swimmers differentiate. The importance of the energetic-tactical factor is highlighting technical-tactical-functional readiness.

The importance of developing all the mentioned segments that constitute 200m medley, with the accent on backstroke and breaststroke segments along with the technical-tactical performance accompanied by adequate psycho-functional readiness, was confirmed. All the analyzed parameters should be put into an optimal ratio.

## P10M-07

**Influence of anthropometric parameters on synchronized swimming performance****Pochon Ariane, Belli Alain**

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*Keywords: performance, anthropometry, synchronized swimming*

The aim of this study was to investigate the possible relationships between performance and selected anthropometric characteristics of elite synchronized swimmers.

7 seniors (age:  $17 \pm 1$  yrs (mean  $\pm$  SD); mass:  $50 \pm 5$  kg; height  $1.64 \pm 0.06$  m) and 10 juniors (age:  $21 \pm 2$  yrs; mass:  $57 \pm 8$  kg; height  $1.65 \pm 0.06$  m) female synchronized swimmers, all members of the Swiss national team, volunteered for this

study. For each subject, density (skinfold fat thickness, quadratic equation method), body mass index (BMI, in  $\text{kg}/\text{m}^2$ ) and buoyancy evaluated by hydrostatic lift (HL, in kg) (Chatard et al. 1990) were measured. Location of the center of mass (LCM in % of height from feet) in foot-head direction was also measured by double weighing at head and foot levels while subjects lying horizontally on a rigid board. Performance was assessed by the official quotations given by the referees at the national Swiss championship in 2001. Spearman's correlation test was used to study the relationships between anthropometric and performance values. T-tests for independent variables were used to evaluate the differences between junior and senior groups. Significance was accepted for  $P < 0.05$ .

Compared to juniors, the senior group showed a higher body mass index ( $20.7 \pm 1.9$  vs  $19.1 \pm 1.9$ ) and a lower density ( $1.05 \pm 0.01$  vs  $1.07 \pm 0.01$ ). Other anthropometric parameters were not significantly different (respectively  $2.49 \pm 0.43$  vs  $2.23 \pm 0.59$  for HL and  $58.1 \pm 0.9$  vs  $58.1 \pm 0.9$  for LCM). Performance was higher in the senior group ( $73 \pm 3$  vs  $68 \pm 5$ ). Density ( $r = 0.78$ ) of juniors and hydrostatic lift ( $r < 0.51$ ) of all subjects (juniors + seniors group) were significantly related with performance. No other relationships were significant, however it should be mentioned that a tendency between center of mass location and performance ( $r = 0.72$ ,  $P < 0.1$ ) was also found in senior swimmers.

The main result of this study is the significant relationship obtained between performance and hydrostatic lift. It shows that anthropometric parameters could influence performance in elite synchronized swimmers, indeed a good hydrostatic lift could help the swimmer to maintain an elevated body position well appreciated by the referees. However density was not related to hydrostatic lift, showing that indirect density measurement may not reflect accurately the anthropometric specificities of the swimmers. Finally, the positive tendency observed between LCM and performance suggests that a high LCM, i.e. located near the centre of hydrostatic lift, could favour the control of balance by synchronised swimmers.

## P10M-08

**Estimation of cycling performance from responses to a single ramp test****Pouilly Jean-Pierre, Chatagnon Michel, Thomas Vincent, Busso Thierry**

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*Keywords: performance, critical power, anaerobic working capacity*

Monod and Scherrer (1965) showed a hyperbolic relation between exercise power and duration using 2 parameters named critical power (CP) and anaerobic work capacity (AWC). These parameters have been estimated from several time trials at fixed power or from several ramp tests. The aim of this study was to estimate the 2 parameters from a single ramp test and to compare them to those fitted from 4 rectangular trials and 4 ramp tests. The sustained power during rectangular trials were then compared with power calculated from CP and AWC estimated from each single ramp test.

12 healthy males volunteered to be subjects for this study after they signed a written informed consent. They did progressive ramp tests to exhaustion with a slope of  $15\text{W}\cdot\text{min}^{-1}$  and  $30\text{W}\cdot\text{min}^{-1}$  and time trials for 4 different power levels: Level 1: 110% of peak power; Level 2: peak power; Level 3: midpoint between peak power and power at

VT; Level 4: slightly over power at VT. CP and AWC were estimated (1) from the 4 constant power trials using 2 linear and 1 non linear models, (2) from the 4 ramp tests and (3) from each single ramp test. CP was estimated from the power at the ventilatory threshold and AWC from the limit time (t) and ramp slope (s) as  $AWC = (t - CP/s)^2 * s/2$ .

No significant difference was observed for CP estimated from the different models (1) from 227±31W to 212±29W when using 4 rectangular tests, (2) 228±28W for 4 ramp tests, (3) 222±40 W for a single 15 W.min<sup>-1</sup> ramp test and 208±46 W for a single 30 W.min<sup>-1</sup> ramp test. Significant difference in AWC was only observed for the non linear model with 4 rectangular tests (30.5±9.5 kJ) which was higher than estimated from the 4 ramp tests (17.2±9.0 kJ,  $p < 0.05$ ) and from a single 15 W.min<sup>-1</sup> ramp test (19.2 ± 5.7 kJ,  $p < 0.05$ ). The difference for a single 30 W.min<sup>-1</sup> ramp test (22.6 ± 7.0 kJ) did not reach the limit of statistical significance. When power was calculated from CP and AWC estimates, statistical differences appeared only at level 3.

This study showed that AWC was underestimated when using ramp tests compared to rectangular trials. However, no difference was observed for CP and AWC estimates when using the 4 ramp test or a single one. When power was calculated from CP and AWC estimates, these parameters seemed to partly compensate each other since the underestimation of AWC yielded to underestimation of exercise power only at the level 3. Estimation errors could arise also from underlying model used in this study.

#### P10M-09

### Hypoxia inducible factor-1alpha (HIF-1a) mRNA expression is enhanced in human

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**Keywords:** gene expression, leukocytes, hypoxia

HIF-1 is a transcriptional factor playing a key role in cellular responses to low oxygen tension. This heterodimeric protein is made up of two subunits named HIF-1a and HIF-1b. The beta protein is constitutively expressed whereas HIF-1a expression is tightly linked to a reduced oxygen level. HIF-1 complex up-regulates the transcription of different genes that are responsible for adaptation to hypoxia. The aim of our study was to determine if sudden low oxygen pressure could increase HIF-1a mRNA level in leukocytes.

We submitted a group of elite cross-country skiers (n =11) to a 10 min hypoxic test consisting of a submaximal (30% of the normoxic VO<sub>2</sub>max) cycling exercise at a simulated altitude of 4800m. Blood samples were collected before and after the test. Leukocyte total RNA was extracted and reverse transcribed. Using real time PCR, we determined HIF-1a mRNA levels in leukocyte total RNA before and after the hypoxic test.

Basal values were very different between all the subjects. A significant HIF-1a gene expression increase was observed after the hypoxic test. The range of values of the responses to hypoxia were very variable between the 11 subjects (-30% to +500%).

In conclusion, human leukocytes express HIF-1a gene, in leukocytes, HIF-1a mRNA expression rapidly responds to acute hypoxia, response range is subject-dependent.

#### P10M-10

### Importance of aerobic and anaerobic energy release and muscular strength during short-lasting exhausting bicycle exercise of elite cyclists

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**Keywords:** cycling, power output, energy supply

A maximal intensity cycling test of 75 s duration has been established, based on the principles of the Wingate Anaerobic Test, with power output (P) being measured directly at the cranks. P decreases exponentially from peak power during the beginning, approaching an asymptote during the final seconds of the test. PPT data has been related to data derived from an incremental exercise test (IET) and a maximum isometric strength test using linear regression.

19 elite cyclists completed the tests. Maximum power (P<sub>max</sub>) as the highest single value and P<sub>10s</sub> and P<sub>pav</sub> as the arithmetic mean of the initial 10 s and the plateau of the PPT were calculated. P at 2 mmol/l lactate level (Plac2) and at exhaustion (P<sub>exh</sub>) were determined from the lactate-power curve derived from IET. Maximal unilateral isometric leg extension force (F<sub>max</sub>) was measured using a leg-press. Stepwise multiple linear regression has been conducted to identify those factors best predicting the performance of PPT. P was 3.0 ± 0.8 and 4.8 ± 0.4 W/kg for Plac2 and P<sub>exh</sub> in the IET, and 13.5 ± 1.7, 11.6 ± 1.4 and 5.7 ± 0.5 W/kg for P<sub>max</sub>, P<sub>10s</sub> and P<sub>pav</sub> in the PPT. Mean F<sub>max</sub> was 25.8 ± 3.3 N/kg and mean BM 67.7 ± 4.9 kg. BM explained 56% and 63%, together BM and P<sub>exh</sub> explained 69% and 71% of the variance of P<sub>max</sub> and P<sub>10s</sub>, respectively. Neither the inclusion of F<sub>max</sub> nor of Plac2 improved the squared correlation substantially. In contrast to this Plac2 explained 62% of the variance of P<sub>pav</sub>; the other variables were rejected.

P during PPT was determined predominantly by BM and P<sub>exh</sub> regarding P<sub>max</sub> and P<sub>10s</sub> and by Plac2 regarding P<sub>pav</sub>. It can be assumed, that P<sub>pav</sub> depends on the capacity of aerobic energy supply. Major fraction of energy within the initial 10 s of maximum cycling exercise is supplied by ATP-PC system (1). This might explain the high influence of BM that is proportional to absolute amount of ATP-PC storage. Anaerobic lactic acid metabolism contributes to P after 3 to 5 s of maximal exercise as well as to P at exhaustion during incremental exercise tests (1). This explains the correlation between P<sub>exh</sub> and P<sub>10s</sub>. Muscular strength played a minor role, which is surprising since peak pedal forces occur at 90° crank angle and hence during the leg extension phase.

The PPT is suitable for testing cyclists' anaerobic as well as aerobic capabilities with reduced time requirements.

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#### P10M-11

### Power training and biarticular muscle function in vertical jumping

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**Keywords:** training, strength, coordination

One specific function of biarticular muscles, i.e. regulate distribution of joint moments in multi-joint actions, is not utilised during isolated one-joint movements. The aim of this

study was to examine if this affects power training for multi-joint actions. We compared power training in which the biarticular muscle function is exploited (multi-joint movements) with a similar training form in which it is not (single-joint actions). Vertical jumping was used as the performance paradigm.

20 well trained subjects were assigned to one of two training groups, matched for jumping performance. One group trained two single-joint actions, knee extension squats (SQ) and plantar flexion (PL) (SQ+PL), the other group trained a combined movement of plantar flexion and knee extension squats (SQPL). All movements were performed as explosively as possible with the restriction that one did not leave the floor or made additional movements in other joints. All movements were done with a weight of 40% of maximal isometric squat strength. A five week training period was imposed, three training sessions per week. Each session consisted of 5 x 6 SQ + 6 PL repetitions (SQ + PL) or 5 x 8 SQPL repetitions (SQPL), leading to comparable total workloads for both groups. Training effects were studied for all training movements and vertical jumping using dynamics measurements and surface EMG of gastrocnemius and vastus medialis.

A significant training effect on the trained movements amounted from 6 to 16% in peak power, depending on training group and movement. The main training effect (for both groups together) for the SQPL movement was significantly larger than for the SQ+PL movement. Both training groups improved their performance in a similar manner. Vertical jumping did not improve. However, coordination patterns in jumping had changed differently for the two groups. It seems that the SQPL group has shifted their sequence toward hip extension first, followed by a tightly coupled knee extension+plantar flexion, whereas the SQ+PL groups has shifted toward a more tightly coupled hip+knee extension first, followed by a more isolated plantar flexion.

The current findings do not support the idea that training whole multi-joint movements is superior to training single joint movements. However, changes in coordination patterns during jumping performance indicate that some training effects may have been initiated but not yet advanced to the level of performance improvement.

#### P10M-12

### Canonical relations between basic and specific motor abilities in female handball players at younger ages

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*Keywords: handball, motor abilities, speed strength, explosive strength*

Modern handball playing is characterised by different movement structures of handball players, with or without the ball, in as short time span as possible. Due to high demands imposed by fast playing, an efficient player must have highly developed anthropological characteristics, primarily basic and specific motor abilities. Precisely, these abilities enable a player to win advantage in attack and defence in situation-related conditions of playing. The aim of this research is to establish the relations between two different, but relatively homogenous set of the basic and specific motor variables. Under the assumption that specific motorics explains the player's efficiency better, we can also speak about the connection between basic motorics and efficiency in handball.

The sample comprises thirty-six female handball players from "Split Kaltenberg", woman's handball team from Split, aged twelve and thirteen years. To evaluate basic motor abilities, the following tests have been applied: explosive strength in the aspect of horizontal and vertical take-off, the explosive strength of the chest throw, speed strength, the repetitive strength of trunk bending, agility, the hand movement frequency, and flexibility. To evaluate specific motor abilities, six tests have been applied: speed strength of moving with the ball, explosive strength of throwing, speed endurance of throwing for the purpose of passing the ball, speed movement strength and the change of course with the ball, situation-related shooting accuracy, and specific explosive strength of the take-off. For the purpose of determining and examining the relations between these two sets of variables, we have used canonical correlating analysis.

Handball is dominated by explosive sprints, jumps, the speed strength of moving with or without the ball, rapid change of course, chest throws etc., and not long-term repetitions. Precisely for this reason, this research, as most of them so far, has proved the statistically significant connection between the explosive and speed strength tests in relation to the efficiency level in specific motor tests, as well as lower values in the tests describing the repetitive strength of trunk and flexibility.

#### P10M-13

### Training process intensification for skilled athletes in fencing at pre-competitive stage of preparation

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*Keywords: efficiency, fencing, training process intensification*

Increased competitive practice is an efficient means to mobilize functional resources in the body of athletes, stimulate adaptation processes and increase the efficiency of preparation process on this basis. The purpose of the work was to intensify the training process of preparation for skilled fencers at pre-competitive stage on the basis of competitive exercises used in different-direction sessions.

Pedagogical, psycho-physiological investigation methods and that of mathematical statistics were used in this work.

Competitive exercises were developed in fencing as result of skilled-fencer preparation process analysis, questionnaire design of leading coaches and athletes. The investigation was conducted in structure and content of martial practice. The five groups of exercises having physical, technical, tactical, physiological and integral directions were picked out. Competitive exercises used selectively in different-direction sessions within accentuated microcycles, whereas of special preparatory and additional means increased the volume of martial practice in training process by 40% ( $p < 0.05$ ). The volume of functional activity in the body of athletes was elevated. The above was confirmed by the data reflecting psycho-functional state of athletes. After the use of special preparatory and additional means, reliable changes in psycho-physiological indices were observed in 20% of the values registered in athletes. During competitive exercises, the number of such registered values increased by 39.3% ( $p < 0.05$ ). By results of the experiment conducted it was established that efficient pre-competitive preparation depended on volume and direction of loads modelled in competitive activity for the athletes. Proposed version of major training means distribution improved sports

performance, efficiency of martial activity and jam-resistance in the athletes during competition ( $P < 0.05$ ). Increased volume of martial practice by means of competitive exercises used in different-direction sessions provided intensification of pre-competitive preparation process for skilled athletes. The athletic result was reliably increased.

#### P10M-14

### Diagnostics of conditioning status of elite male handball players in Croatia

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**Keywords:** handball, testing, conditioning

It has been shown that external ankle stabilizers have mechanical as well as neuromuscular effects at the ankle joint. Many authors investigated the preventive effects of external ankle stabilizers and the influence on motor performance in different kinds of sports. However, long term effects of preventive bracing on the neuromuscular system and ankle joint mechanics have not been published yet. The purpose of this study was to investigate the neuromuscular and mechanical effects of continuously ankle bracing over a 4 weeks period.

A total of 10 male volunteers participated in this study (35.8±5.6 years; 76.3 ±7.6kg). Pre and post measurements comprised examinations of maximum isometric and isokinetic eversion strength (MVC) (KinCom 500H) and electromyographic recordings from M. peroneus, M. tibialis,

M. gastrocnemius med. and M. soleus. A tilt platform was used to produce an unexpected inversion (30°) and plantar flexion (15°) stress at the ankle joint. The reflex activity of 4 ankle joint muscles was quantified by integrating the rectified and averaged emg-signals (iEMG). All subjects were instructed to wear unilaterally an individually adapted ankle brace (Aircast®) 24h a day. They performed their normal daily activities including work and even leisure sports activities.

Mean of maximum isometric eversion strength (MVC) showed no statistical significant differences between pre experimental and post measurements. EMG activity of the M. peroneus during MVC was not affected. Mean ankle joint inversion amplitude during sudden tilt movement was nearly the same ( $20.8 \pm 9.1^\circ$ ) compared to measurements prior to the bracing period ( $21.3 \pm 5.4^\circ$ ). The EMG recordings of the M. peroneus before and after the experimental period were not found to be affected significantly.

From immobilisation studies one could conclude that the more or less permanent use of braces could cause atrophy to the neuromuscular system or damage to soft tissue (Akeson et al. 1987). After 4 weeks of bracing using an Aircast® Ankle brace no influence on isometric maximum eversion strength was measurable and reflex activity was not affected. It seems unlikely that neuromuscular properties of the muscles stabilizing the ankle joints are affected. The preventive use of ankle stabilizers, however, should always be accompanied by specific sensomotoric stabilization training in order to optimise the neuromuscular system and to ensure the highest protection level for the ankle joint.

## Poster Session

### Training and Testing 2

#### P10N

#### P10N-01

### Genetic endowment and sport performance

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**Keywords:** high performance, twins

A pair of high performance twin athletes, included in a larger study, may prove particularly enlightening with respect to the relative importance of genetic factors, in the modulation of athletic excellence (Klissouras et al, 2001). A World Champion gold medallist in karate and his twin counterpart, also an athlete in the same sport, but with inferior performance, were tested in order to shed some light on genetic causation of sport performance.

Subjects were two 23-year-old identical twin brothers. Their zygosity was established through direct observation, the testimony of the obstetrical clinic and by serological examination. Both twins had undergone strenuous, long-term training for 13 years, since the age of 10 under the guidance of the same coach. Measurements were made on anthropometrical characteristics, maximal velocity in elbow flexion, force and power in high velocities, EMG activity in the maximal isometric contraction and neuromuscular coordination, as defined by accuracy and economy of movement in selected velocities.

The assessment of their bio-profiles showed, that intrapair differences were negligible in all parameters under study. Respective values for the World Champion and his brother were as follows: height 164.5 and 165.0cm, weight 58 and 58kg, maximal velocity 4.69 and 4.55m/s, force and power in

70% of Vmax 52 and 54N, and 127.9 and 119.8W, neuromuscular coordination expressed as accuracy in 30% Vmax 0.6 and 0.85cm, in 50% Vmax 1.2 and 1.6cm, in 70% Vmax 2.5 and 2.9cm, neuromuscular coordination expressed as economy in 30% Vmax 0.08 and 0.1mV, in 50% Vmax 0.135 and 0.155mV, in 70% Vmax 0.23 and 0.25mV, and EMG activity in maximal isometric contraction 0.904 and 0.857mV.

Findings suggest that although genetic constitution and years of physical training are prerequisites for making a World Champion athlete, success may be largely influenced by other traits, beyond the realm of Biology.

Klissouras et al (2001). *International Journal of Sports Medicine* 22: 250-255

#### P10N-02

### Optimising the success of learning of tennis basic strokes with advanced beginners

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**Keywords:** tennis, learning, tennis training

The study's aim is to find out how 4- and 16-stroke sequences in a series (sis) influence the stroke's precision and velocity of forehand and backhand.

Ten regional male elite tennis players (ep) and ten male advanced beginners (ab) (age  $24.2 \pm 1.5$  years (ep) and  $21.6 \pm 1.5$  (ab); BMI  $22.2 \text{ kg/m}^2$  (ep) and  $23.5 \text{ kg/m}^2$  (ab)



attend the same test taking place on two different days each in an interval of one week. The test consists of the following: endurance interval (EA) with 256 balls, two intensive endurance exercises (IA1, IA2) with 96 balls each. The second intensive endurance test (IA2) is interrupted by two two-minutes lasting breaks each taking place after 32 balls. The first day of exercise differs from the second one regarding the number of strokes per series (4 and 16).

Stroke velocity in EA (ep: 4 sis: forehand (fh)  $120,65 \pm 6,79$  – backhand (bh)  $111,98 \pm 7,44$  vs 16 sis: fh  $116,93 \pm 4,41$  – bh  $108,61 \pm 6,73$ ; ab: 4 sis: fh  $108,08 \pm 5,36$  – bh  $101,95 \pm 6,94$  vs 16 sis: fh  $108,09 \pm 8,74$  – bh  $99,69 \pm 7,67$ ), IA1 (ep: 4 sis: fh  $123,98 \pm 7,78$  – bh  $113,52 \pm 7,96$  vs 16 sis: fh  $108,89 \pm 6,00$  – bh  $100,36 \pm 5,11$ ; ab: 4 sis: fh  $107,89 \pm 6,87$  – bh  $100,66 \pm 7,28$  vs 16 sis: fh  $105,13 \pm 6,28$  – bh  $97,01 \pm 7,09$ ) and IA2 (ep: 4 sis: fh  $124,82 \pm 7,57$  – bh  $114,05 \pm 8,25$  vs 16 sis: fh  $112,01 \pm 7,95$  – bh  $104,27 \pm 7,60$ ; ab: 4 sis: fh  $108,86 \pm 5,60$  – bh  $100,90 \pm 6,23$  vs 16 sis: fh  $104,49 \pm 7,07$  – bh  $99,15 \pm 7,04$ ) showed highly significant differences between forehand and backhand as well as between the different series.

In all three tests (EA: ep 4 sis: 42,7 vs 16 sis: 44,1 and ab 4 sis: 22,0 vs 16 sis: 21,00 strokes in target, IA1: ep 4 sis: 12,0 vs 16 sis: 11,6 and ab 4 sis: 8,9 vs 16 sis: 7,4 strokes in target and IA2: ep 4 sis: 13,5 vs 16 sis: 12,1 and ab 4 sis: 7,6 vs 16 sis: 8,3 strokes in target) the precision of the stroke remains unchanged. The analysis of the errors (occurred during the process) will show much more details especially in regard to the differences between forehand and backhand.

For optimising the success of learning of basic strokes in tennis, series of four balls are recommendable since the work load is less than in a series of 16 balls while the precision of the stroke remains the same. The analysis of the errors (occurred during the process) with differentiation of forehand and backhand will show the best training load and will give further information on the effect of four strokes in series vs 16 strokes in series.

### P10N-03

#### Physical structure and aerobic/anaerobic fitness of top-class Portuguese line-skaters

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**Keywords:** aerobic fitness, physical structure, anaerobic fitness, in-line skating

Studies on somatotype of athletes in a variety of sports have been summarized by Carter & Heath (1990). This study describes and compares the somatotypes of male and female Portuguese top-class line-skaters. The sample consisted of 16 top-class speed-skaters (10 males, 17.8 years of age; 6 females, 16.8 years of age) selected for the national team. Somatic characteristics included body measurements used to determine somatotype (Carter & Heath, 1990) and androgyny index (Tanner et al., 1951). In addition, aerobic and anaerobic fitness were assessed using the 20-meter shuttle run (PACER) and the 30-second anaerobic test (Wingate test). This test permits to determine anaerobic peak power (APP) and anaerobic mean power (AMP). Both scores were analysed in terms of absolute values (APPA, AMPA) and relative values expressed for unit of body weight (APPR, AMPR).

The mean somatotype of the skaters were 3.1-4.6-2.7 (balanced mesomorph) and 4.0-4.8-2.0 (endo-mesomorph) respectively for males and females. Compared to US college

data (see Malina & Zavaleta, 1976), female skaters (83.85) were somewhat more androgynous than non-athletes (77.6), middle-distance track and field runners (80.3) and sprinters (81.98), while jumpers (84.95), javelin throwers (86.47) and shotputters (88.89) presented higher scores. For males, data from world top athletes (Garay et al., 1974; Tanner, 1964) show that the mean of skaters (93.47) is over the mean of long-distance (90.1) and middle-distance (92.2) track and field runners, and is below the mean of sprinters (94.7), jumpers (96.9), javelin throwers (96.3) and shotputters (102.6).

In summary, somatotypes of line-skaters are principally localized in the mesomorph area. They tend to be more androgynous than non-athletes and distance runners, but less androgynous than jumpers and throwers. Within male subjects, athletes having bigger body size tend to attain higher values in anaerobic absolute parameters, but poorer performances in aerobic capacity, as well as in anaerobic tests when expressed per unit of body weight.

### P10N-04

#### On- and off- water vertical jump in water polo players

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**Keywords:** vertical jump, water polo

The performance of the vertical jump constitutes a fundamental technical ability in many team sports including the water polo where the player very often have to move his body vertically off the water in order to shoot the ball, or to prevent the opponent from shooting or passing the ball. The purpose of the present study was therefore two fold: firstly, to evaluate the ability of the water polo players to move their bodies vertically off the water and secondly, to determine on the same players their lower bodies' explosive strength ability while performing a vertical jump on 'dry-land'. We also investigated whether the performance of the on-water vertical jump depends on the position of the players in the game and on the competitive level.

Forty-three water polo players, were tested on-water and on dry-land. The on-water vertical jump was assessed using a board with a centimeter scale attached to it. A video camera that was placed facing the board was used to record the trials of the players. The players were required from the fundamental floating position to move their bodies upward and touch the board on the highest position that they could reach on three different occasions. The subsequent video analysis allowed identification of the distance between the surface of the water and the highest point reached by the player. Pearson's correlation coefficient was used to calculate the relationships between the on-water vertical jump and the jump on dry-land. The within different players positions differences were detected by One-way ANOVA followed by Tukey's post-hoc comparisons when appropriate. T-test for unpaired observations was used to identify differences in vertical jumps between two groups that were formed according to the level of competitiveness.

The mean value of the on-water jump was  $68.3 \pm 4.6$  cm, whereas the mean value of the dry-land jump was  $49.6 \pm 6.5$  cm. The coefficient between the two jumps was very low ( $r=0.25$ ). Significant differences between the two jumps according to players' positions and to the level of competitiveness were found. Test re-test reliability between the on-water trials was found to be high ( $r=0.93$ ).

In conclusion, the performance of the on-water vertical jump correlates poorly with the explosive ability of the lower body as that was assessed by the dry-land vertical jump. Furthermore, the ability to move the body vertically on-water differs significantly among players, depending on their position and on the level of competitiveness.

#### P10N-05

### Is self-paced walking suitable for studies of oxygen uptake kinetics in frail elderly women?

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**Keywords:** *elderly, self-paced walking, oxygen uptake*

Current methodologies to examine oxygen uptake (VO<sub>2</sub>) kinetics involve cycle or treadmill ergometry, usually within a laboratory setting. However, this approach is problematic when one considers frail elderly people. This study has examined the use of self-paced walking as the mode of exercise. The purpose of this study is to determine whether comfortable self-paced walking can be described as 'constant load' exercise, and if so, to examine whether existing modelling techniques adequately describe the on-transient VO<sub>2</sub> (phase 1 and 2) response to this form of exercise.

VO<sub>2</sub> kinetics and walking speed were measured during three minutes of comfortable self-paced walking around an elliptical circuit in five young women (median age 22 years, range 19-23 years), five healthy elderly women (median age 78 years, range 77-80 years) and eleven elderly women who had suffered a hip fracture (median age 81 years, range 72-91 years, median time since fracture 5 months, range 2-13 months). The individual breath-by-breath responses for three repetitions were interpolated on a second-by-second basis and ensemble averaged to provide a single data set.

Comfortable self-paced walking could be described as 'constant load' exercise (coefficient of variation of individual lap speeds, young 2.7% (median), 0.9-4.6% (range), healthy elderly 1.9%, 0.8-3.7%, hip fracture 4.3%, 0.3-36.4%). The oxygen uptake data were adequately described using a non-linear monoexponential model (Sy.x values (standard deviation of residuals) young 0.0372 l.min<sup>-1</sup> (mean value), healthy elderly 0.050 l.min<sup>-1</sup>, hip fracture 0.042 l.min<sup>-1</sup>; R<sup>2</sup> values young 0.96 (mean value), healthy elderly 0.92, hip fracture 0.88).

This approach may provide the basis to examine oxygen uptake kinetics in individuals not capable of more traditional ergometry techniques.

#### P10N-06

### A kinematic study of the pumping movement in Olympic sailboard

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**Keywords:** *3D analysis, sailboard, pumping movement*

A better knowledge of the pumping movement in Olympic sailboard with consideration of kinematic and mechanical parameters will provide the basic guidelines for training elite athletes in order to gain an optimal pattern of the movement. The purpose of the present study is to identify the characteristics of a specific type of pumping movement (low

rear wind velocity and high amplitude of oscillation) in olympic sailboard using a 3D motion analysis system (DLT computation). The pumping movement in sailboard has been investigated through a collaborative research work between Aerodynamics and Biomechanics of Motion Laboratory (LABM) and the French Sailing Federation (FFV).

The data reported in the present paper concern a specific experiment performed on May 2002 in the High Level Training Center of Marseille (France) and which has been based on video recording and kinematic data analysis of the sail mast movement. The video system consisted in three synchronized digital cameras located around a specific nautical track and recording multiple passing of one elite sailboarder. The whole space measurement (intersection of camera fields) was 15m x 10m in size. Passive markers were distributed all along the sail surface and the mast of the sailboard.

In particular, results have also provided the clear identification of different phases of traction and slide during a complete pumping movement cycle. Finally this study provides a visualisation software which gives to the coaches and athlete kinematic data on the sail and video information while the athletes pass through the nautical track. The present software version allows coach and athletes to quantify pumping mechanisms in order to identify the influence of the technical changes on the resulting movement produced by the athlete.

#### P10N-07

### Comparison between two resistance training regimes: superslow vs. traditional training

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**Keywords:** *resistance strength training, superslow, strength gain*

Various resistance training strategies are commonly used in order to improve strength in those athletes involved in sports that require muscular power. In Italy, many track and field coaches utilise a resistance training regime consisting in 10 RM per 10 series. However, some coaches are used to experiment different resistance training regimes in order to avoid training monotony especially in more experienced athletes. One of the most "original" alternatives is a strategy similar to the superslow-method in which the execution of the repetition is performed slowly. Thus, the aim of this study was to verify the effect on muscular strength of these two resistance training regimes.

Twelve male subjects with more than 5 years of resistance training were involved in the study. They were randomly assigned to two groups: superslow-method group (SG) and traditional-method group (TG). The superslow-resistance training method consisted of 6 consecutive series of 6 repetitions starting with 70% of 1 RM, decreasing the load of 20% in series 2 and 3, and decreasing of 10% in the following 3 series. The traditional method consisted of 10 series of 10 RM with 3 min of recovery between series. The subjects trained 3 times a week for 8 weeks. Before and after the training period a 1RM tests on different muscular groups were taken. Due to the low number of subjects a non parametric statistic was used (X<sup>2</sup> test).

Five subjects for each group completed the study. Both groups significantly improved strength of all the muscular groups (from 5.9% to 23.5% in TG, and from 7.3% to 15.7% in SG). No differences were found between the two groups in strength gain.

The results of this study showed that both the two resistance training regimes determined significant strength improvements. As no difference between groups was found, the use of the superslow-method seems to be acceptable as alternative to the traditional 10x10RM method widespread in Italy for track and field athletes. However, in a similar study, Keeler et al. (2001) found better gains in athletes trained using traditional-speed resistance training compared to the superslow-method. Strength gain for leg in TG was 7.8 % higher than the SG but not statistically different (possibly due to the low number of subject). Moreover, further studies are necessary to verify eventually different effects on power and/or specific performance.

Keeler et al. (2001)

## P10N-08

### Physiological significance of critical velocity

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**Keywords:** VO2max, critical velocity, critical power

There is evidence that critical velocity ( $V_{critical}$ ), which is derived using the hyperbolic relationship between velocity and time to fatigue, is the threshold intensity above which VO2max can be elicited in running.

In this study, nine individuals performed a series of exhaustive treadmill tests at different velocities selected to result in fatigue in ~3 min to ~10 min. The relationship between velocity and time to achieve VO2max at each velocity was described using a model that generated three parameters,  $V_{critical}$  (the threshold velocity above which VO2max can be elicited),  $k$  (a constant determined by the kinetics of the VO2 response), and  $A'$  (whose significance is unclear).

$V_{critical}$  ( $173 \pm 28$  m·min<sup>-1</sup>) and  $V'_{critical}$  ( $180 \pm 43$  m·min<sup>-1</sup>) did not differ ( $P = 0.400$ ). By calculating the point at which these two curves intersected, it was possible to determine the minimum time in which VO2max could be attained. The minimum time necessary to achieve VO2max was calculated to be 201 s, at a velocity of 250 m·min<sup>-1</sup>.

These results show that a single three-parameter hyperbolic model of the relationship between velocity and time to achieve VO2max, a model that acknowledges that there is a minimum time needed to attain VO2max, with the results of as few as three tests, can be used to determine both the minimum velocity and the minimum time (or maximum velocity) for which VO2max can be attained.

## P10N-09

### The athletes' cardiorespiratory responsibility changes induced fatigue of strenuous training workloads

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**Keywords:** fatigue, cardiorespiratory responsibility

It was supposed that high performance athletes' vigorous training sessions induced fatigue is connected with decrease of cardiorespiratory (CRS) responsibilities (Mishchenko, Monogarov 1995). As an integral image changes in drive activity CRS and its kinetics could be seen. The aim was to define such changes in elite rowers.

Twelve elite male rowers aged 19-25 years were repeatedly examined in the morning at the day before (after recovery day) and in the next day after strenuous (about maximal) training load series (two sessions a day) typical for the given category of athletes. The second session - it was intermittent type of workload. CO2 and normocapnic hypoxia CRS sensitivity in rebreathing tests (standard rest) as well as VE, VO2 and HR kinetics (monoexponential function) at 0.7 VO2max (transition from 25w, specific ergometer) were measured (Ward et al 1996). A set for metabolic researches "Oxycon Alfa" (Jaeger), sport testers "Polar" were used. The Statistics 5.0, PL in "Excel 97" packet was used.

The results show that in the next day morning after series of high loading training sessions there was marked a tendency and true changes of sensitivity and kinetics CRS. In comparison with initial level delta (VE) / delta (PACO2) was significantly decreased from 1.53 (0.11) to 1.34 (0.10) l·min<sup>-1</sup> per 1 mm Hg ( $p < 0.05$ ). Sensitivity VE and HR to hypoxia responses were increased markedly ( $p < 0.001$ ). The fast part of VE response with 8 from 12 examined athletes was decreased ( $p < 0.05$ ). Half time (T50) VO2 response significantly increased from 24.1 (1.3) to 29.6 (1.4) s ( $p < 0.05$ ). There was interrelation induced fatigue changes sensitivity to CO2 and kinetics (T50) VE and VO2 ( $r = -0.62$  and  $-0.54$ , respectively,  $p < 0.05$ ).

It was shown that in 12-14 hours after vigorous training series mainly intermittent type high performance rowers, CRS response sensitivity to CO2 and response kinetics were less than after recovery day. It may be important integral image of fatigue specificity intermittent or similar types of training workloads. Such CRS responsibility changes induced fatigue appear to be temporarily limits abilities to respond quickly and adequately to next work loads and modify its training effects.

Mishchenko V, Monogarov V (1995). *Physiology of athlete*, Barcelona

Ward S et al (1996). *Cong Eur Coll Sport Sci*: 268-9

## P10N-10

### Non-contact jumping diagnostic system

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**Keywords:** diagnostics, flight time, jumps

Force platforms are frequently used to measure the take-off power in performance diagnostics. However, the use of a platform to determine vertical jump is relatively expensive, probably less sensitive to the training improvements, and always represent only a laboratory model of jumping performance that may be different from the jumping performance in the field conditions, mainly in regard to different characteristics of the surfaces, used in the sports practice. Also the size of fabricated platforms is relatively small and therefore may represent a potential risk of injury. The aim of the study was to develop a non-contact jumping diagnostic system that may be used in the field conditions on the various surfaces, specific to particular sports and games.

Theoretically, jumping performance include the process of developing kinetic energy ( $0.5mv^2$ ) that is changed into potential energy (mgh). At the maximum jump height, the velocity is equal zero, and potential energy is maximal. During the drop phase, the potential energy is changed to the kinetic energy, and omitting the air resistance, the velocity of take-off is equal to the velocity of decent. Therefore, the velocity of take-off is equal  $(2gh)^{0.5}$ , and considering the equality of a trajectory of rectilinear movement and those of a free-fall, the velocity of take-off is equal  $0.5gtF$ , where  $tF$  is

flight time of a jump. By comparison of these two formulas it is possible to estimate the height of the jump directly from the flight time  $h = 0.125 \cdot g \cdot t^2$ . Non-contact jumping diagnostic system was based on the measurement of the flight time using the series of photocells and principle of interruption of light rays during the take-off and decent. The measurement is performed in a space 1.3 x 1.3 m, inside an aluminium quadratic frame. One side of the frame is planted by 16 transmitting infrared LED, and the opposite side has 16 electronic amplifiers with infrared sensors at the input. The system creates 16 independent parallel optical trajectories, at a distance of 7cm from each other. Flight time is measured as a time, when none of these optical rays is not interrupted. Because of interference of ambient light the rays of transmitter side are modulated by a frequency of 40 kHz. Online evaluation allows the measurement of the single flight time and/or cumulative flight time during the preselected duration of the test and consequently the calculations of contact time and number of jumps.

### P10N-11

#### Stability of target heart rate in untrained adults over 1-year marathon training

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**Keywords:** heart rate, endurance exercise, untrained subjects

Recommendations for training prescription are based on exercise performance testing. Especially heart rate monitoring is an easy tool to control the individual training intensity. Few studies documented a stability of the target heart rate in trained (Lucia et al. 2000, Foster et al. 1999) and untrained (Hurley et al. 1984 and Saltin et al. 1969) adults at aerobic and anaerobic threshold. Because of a lack of long-term studies it was the aim of our investigation to analyse the stability of target heart rate in untrained adults over one year marathon training.

Twenty nine adults (n=15 female: 40.9 ±5.2yr, 66.9 ±11.4kg, 24.1 ±4.0BMI, 33.6 ±3.6 ml min<sup>-1</sup> kg<sup>-1</sup> VO<sub>2</sub>; n=14 male: 42.5 ±4.6yr, 82.6 ±12.2kg, 25.7 ±3.2BMI, 36.9 ±3.6 ml min<sup>-1</sup> kg<sup>-1</sup> VO<sub>2</sub>) completed an incremental treadmill test until exhaustion every 13 weeks over one year (5min, 1.8 km h<sup>-1</sup> increment, 30s rest, 1% incline). Blood lactate concentration, oxygen uptake and heart rate were assessed before, during the steps and until the 7th min after cessation. Target heart rate was determined at 2 and 4 mmol l<sup>-1</sup>, as well as HR at 9.0 km h<sup>-1</sup>. Over 4 training periods, lasting 3 month each, training intensity was carried out at 2 mmol l<sup>-1</sup> lactate (aerobic load) representing 96% of the training volume (begin-end: 3-6 /wk, 45-90min/session, 11-36km/wk) was. Repeated analysis of variance was performed and simple effects were tested with pairwise comparisons.

Running mostly at 2 mmol l<sup>-1</sup> lead to a significant improvement in running speed at aerobic and anaerobic levels (p<0.01) and an increase in peak VO<sub>2</sub> during the first 3 month of 32% with a maintenance until the 52nd week (see ECSS 2002). No significant difference was found in the THR at 2 and 4 La between sex and test, whereas a significant decline was found in HR at 9.0 km h<sup>-1</sup> (p<0.05). But high individual deviations were found from test to test (see figures).

Although THR for marathon training is stable in untrained adults over one year (142 ±13bpm) large individual deviations from test-to-test were found (+30 or -20 bpm). From this point of view we do not recommend one test per year for adjustment of running intensity.

Foster et al. (1999). *Med. Sci. Sports Exerc.* 31 (4), p. 578-582.

Hurley et al. (1984). *J. Appl. Physiol.: Respirat. Environ. Exerc. Physiol.* 56 (5), p. 1260-1264.

Lucia et al. (2000). *Med. Sci. Sports Exerc.* 32 (10), p. 1777-1782.

Saltin et al. (1969). *Scand. J. Clin. Lab. Invest.* 24, p. 323-334.

### P10N-12

#### Energy expenditure during professional road cycling competition

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**Keywords:** cycling, energy expenditure, competition

It has been assumed that during road cycling competition energy expenditure of professional cyclists can reach 25 MJ/day depending on the length and topographical difficulty of the race. All available studies used indirect methods for the assessment of energy consumption. Direct measurements of energy expenditure in road cyclists are the aim of this study. Such data could help to refine nutritional programs for athletes and thereby improve cycling performance.

6 professional road cyclists were studied during a 5 day stage race. Energy expenditure was measured directly using a crank dynamometric power measurement (SRM, Jülich, Germany). The device measures the power (Watts) originated by the rider. The energy necessary to provide a given power output was calculated using the formula Energy (Joule) = Power (Watts) x Time (sec). The data was transmitted to a computer for further processing. The cycling efficiency is ~ 25 %. Therefore, total energy expenditure for cyclists was calculated by multiplying the measured energy by 4. Average values for every stage were determined; results were transformed for race distance (km).

The average energy expenditure of 6 riders during the different stages of the race varies between 16,6 KJ/kg and 47,1 KJ/kg or 0,2 and 0,7 KJ/km/ kg body weight depending on the topographical difficulty and tactical implications of the race with higher values in shorter and faster stages. Highest values were found during a 13 km time trial.

Previous studies have estimated energy expenditures during cycling competitions up to 25 MJ/day. With such high energy requirements, many authors have reserved doubts on whether long cycling races can be sustained with normal food intake, based on the argument that energy expenditure during such events is largely superior to maximal energy intake through conventional food. Our data demonstrates that those figures are overestimated. Calculations from our formulas result in energy requirements for road cycling competition that can be met by normal food intake.

During professional road cycling competition, average energy expenditure ranges between 0,2 and 0,7 KJ/km/ kg body weight.

## P10N-13

**Evaluation of training adaptations in young football players**

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*Keywords: adaptation, training, football*

The main purpose of the present study was to verify the training adaptations of some important variables in football before and after 15 weeks of training during the regular season. The sample was composed of 36 subjects, divided in three age groups composed by 6, 12 and 18 players from the under 16, under 18 and under 21 team, respectively, being all of them from the Londrina Junior Team-Parana state, Brazil.

They were submitted to a test battery which included the measurement of the anthropometric variables: body weight (BW/kg), height (H/m), sum of 7 skinfolds (S7SF/mm), thigh (TC/cm) and calf (CC/cm) circumferences, the 40 meters sprint (S40/s), the yo-yo intermittent aerobic resistance test: total distance run (TDYOYO/m), total time (TTYOYO/s), maximum speed reached (MSYOYO/km/h) and the squat jump (SJ/cm), countermovement jump (CMJ/cm) and the countermovement jump with free arms (CMJF/cm). For data analysis and interpretation descriptive statistics was used and for the comparison of the means the student t-test was applied with the significance level set at  $p < 0,05$ .

According to the analysis, it was possible to realize that in all categories there were differences between the means of the pre-test and the pos-test. These differences are shown according to each investigated category: UNDER 16: H= 0,01 ( $t = -3,14$   $p = 0,02$ ), BW= 3,92 ( $t = -5,28$   $p = 0,00$ ), S7SF= -0,78 ( $t = 0,29$   $p = 0,77$ ), CC= 0,85 ( $t = -3,53$   $p = 0,01$ ), TC= 2,95 ( $t = -6,13$   $p = 0,00$ ), MSYOYO= 2,33 ( $t = -2,61$   $p = 0,04$ ), S40m= 0,41 ( $t = -3,92$   $p = 0,01$ ). UNDER 18: H=0,0 ( $t = 2,51$   $p = 0,02$ ), CC= 1,08 ( $t = -3,87$   $p = 0,00$ ), TC= 1,39 ( $t = -5,00$   $p = 0,00$ ), TDYOYO= 1126,66 ( $t = -8,79$   $p = 0,00$ ), TTYOYO= 388,67 ( $t = -8,68$   $p = 0,00$ ), MSYOYO= 2,42 ( $t = -7,87$   $p = 0,00$ ), S40m= -0,21 ( $t = -5,21$   $p = 0,00$ ), and UNDER 21: S7SF= -5,76 ( $t = 0,08$   $p = 0,93$ ), TDYOYO= 726,67 ( $t = -1,15$   $p = 0,26$ ), TTYOYO= 276,56 ( $t = -5,68$   $p = 0,00$ ), MSYOYO= 1,75 ( $t = -6,95$   $p = 0,00$ ), SJ= 1,67 ( $t = -2,91$   $p = 0,00$ ), CMJ= 1,72 ( $t = -1,76$   $p = 0,09$ ).

According to these results, it was possible to conclude that the evaluation of the analyzed variables in both categories was probably influenced in a positive way by the training loads. Therefore, the importance of periodical evaluation must be pointed out, considering that this process allows for a better monitoring of the athletes performance during a regular season and also provides improved conditions to prescribe the training loads more adequately.

## P10N-14

**Selection based on the physical capability of employees at the Bulgarian police and analysis of results as an essential model of the physical capability of population**

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*Keywords: training*

The regular check up of physical capability of each country's population provides important information about many of the management aspects - health, healthcare, life standard, civil

and military necessities. Security turns into a priority in national and worldwide scale due to the serious threats against personality and public order. The role of police is no longer limited to safeguarding and prevention of local crime. Its employees should be able to cooperate in global scale in order to render effective counteraction to dangers, accompanying our modern life. This places the need for the employees to improve their qualification. For every sphere of police activities, it is important to create proper and convenient system for selection of applicants. In the strive for finding possibilities to solve this problem and receive feedback information about this field we have formulated the following objective.

The objective of this study is to present an effective, practice-proven example about selection and professional training of police officials, grounded on the results from their physical training. Using the data so obtained, we are aimed at offering a proposal for assessment of population's physical capability. In the process of the work the experimental research method was applied as created in 1992 and continuing to be implemented even nowadays.

1. An effective system for selection and professional training based on the physical capability of police employees has been established and set into operation.

2. The results from the tests for policemen physical training assessment constitute an essential model and may be used for information and appraisal of physical capability of certain country's population.

*Bachev V., N. Toshkov, L. Velchev, P. Georgiev, Works of the Military Academy, issue 5, 1996.*

*Bachev V., N. Toshkov, P. Georgiev, Scientific works of the National Sports Academy, issue 6, 1998.*

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## P10N-15

**The structure analysis and matrix characteristics of tests for the estimation of basic and specific motor efficiency of female physical education students**

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*Keywords: motor efficiency, structure analysis, female students*

The main task of this study is estimation of basic and specific motor ability structure and evaluation of metric characteristics of applied tests with special aspect on the situation-motor efficiency in Rhythmic Gymnastics.

The total sample to examine included 85 PE female students, 21-23 years old, sub-divided in two groups: Yugoslav (N=40) and foreign citizenship (N=45). The battery of tests for the evaluation of basic and specific motor abilities consists of 34 variables (19 for the basic motor ability and 15 for the RG situation-motor efficiency estimation). Research data were processed with the basic and descriptive statistics. Comparative analysis of results was processed with univariate and multivariate analysis of variance (MANOVA). The structure of examined motor segments was established on the base of factor analysis.

Metric characteristic analysis indicated that only 3 tests fulfilled the criteria for excellent mark (8.8%). The criteria for very good mark fulfilled 16 tests (47.00%). The criteria for good mark fulfilled 8 tests (23.50%) and the other 9 tests (26.00%) did not fulfill established criteria. With MANOVA was established that the examined groups differ statistically significant, which indicated that YU-female students are more

affective in tests for estimation of explosive strength, speed and precision, and the foreign PE female students are more effective in tests for estimation of flexibility and co-ordination. On the base of applied factor analysis it was confirmed that the structure of motor segment is multidimensional. The 1st factor was defined as a factor of general motor capability-efficiency; the 2nd was defined as the factor of flexibility; the 3rd was defined as a factor of synchronizing motion or co-ordination; the 4th factor is bipolar and defined as a factor of balance-precision.

MANOVA confirmed that two examined sub-samples (Yugoslav and foreign PE female students) differ statistically

significant, in general (WILKS LAMBDA = .10; Q = .00). Univariate analysis of variance and t-test point out that the significant differences are established at 10 of 34 variables (29.41%). The majority of the applied measure instruments have satisfied metric characteristics, while 55% of tests have good sensitivity and discriminated relatively well the examined subjects. On the base of this study it is possible to suggest a reduced battery of tests for the estimation RG situation-motor efficiency of PE female students.

## Poster Session

### Training and Testing 3

P100

P100-01

#### Influence of different profiles of the muscular energy metabolism on endurance performance in cycling

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*Keywords: cycling, testing, muscular metabolism*

In road cycling the endurance capacity of the energy metabolism has a major influence on the performance in competition. Most times, the profiles of the muscular energy metabolism which cause the endurance performance, e.g., the power at the anaerobic threshold (AT), are ignored in performance tests and training analysis. In this study, different profiles of energy metabolism and their influence on the power at AT and endurance performance as well as different possibilities to increase this performance have been investigated.

Four road cyclists (subject A to D) (age: 29,25 y  $\pm$  2,77; weight: 77,63 kg  $\pm$  1,47; height: 181,0 cm  $\pm$  3,54) of different sport levels (professional, amateur, leisure sport) participated in this study. The subjects underwent two ergometer tests to record maximum oxidative and glycolytic performance. With these data, the activation of the energy metabolism for steady state conditions at different loads as well as the power at AT was calculated (Weber 2003).

The subjects had different oxidative (VO<sub>2</sub>max: A: 76,07; B: 67,45; C: 70,81; D: 61,41 ml/min/kg) and glycolytic performance (VLmax: A: 0,317; B: 0,313; C: 0,790; D: 0,773 mmol/l/s). Therefore different power at AT were observed (A: 406; B: 362; C: 315; D: 257 watt). For loads low enough to oxidize lactate, the possible power output was different, e.g. at an oxidation rate of lactate of 1,25 mmol/l/min the power output were: A: 386; B: 337; C: 265. In subject D the maximum oxidation rate of accumulated lactate was 1,03 mmol/l/min at a power output of 165 watt.

In this investigation metabolic backgrounds for different power outputs at AT were explained. The calculation of the state of energy metabolism under steady state conditions shows great differences e.g. in the oxidation and production rate of lactate. These observations were made with subjects of same body weight and VO<sub>2</sub>max, but different VLmax (B vs. C). Measuring only VO<sub>2</sub>max or power at AT doesn't supply the physiological background leading to a specific endurance performance. E.g. in case of the amateur cyclist C no great improvements in the AT through increasing the VO<sub>2</sub>max are possible (Mujika and Padilla 2001). To evaluate the physiological background leading to a specific endurance performance, it seems necessary to measure glycolytic and oxidative performance separately.

Mujika I, Padilla S (2001). *Sports Med* 31: 479-87

Weber S (2003). *Diplomarbeit, DSHS Köln*

P100-02

#### Comparative study of heart function of folk dancers and athletes

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*Keywords: folk dance, echocardiography, morphology*

The purpose of this study was to examine whether folk dancing induces changes in heart morphology and/or function. Adaptation of the heart can be similar to some organic heart diseases, like left ventricle (LV) hypertrophy. Systolic murmur, incomplete right bundle branch block (RBBB), early repolarisation (ST, T abnormalities on ECG), sinus bradycardia, sinus arrhythmia and LV hypertrophy were already accepted as pathophysiological changes in heart function of athletes. These abnormalities are not caused by a definite heart disease but rather a slightly abnormal physiological adaptation of the heart in response to exercise. 24 folk dancers agreed to participate in our study, 13 female (age 21 $\pm$ 5 yrs, height 167 $\pm$ 3 cm, body weight 59 $\pm$ 8 kg) and 11 males (21 $\pm$ 4 yrs, height 180 $\pm$ 6 cm, body weight 70 $\pm$ 8 kg). The control group included 16 university students of physical education, 9 female (age 22 $\pm$ 1 yrs, height 167 $\pm$ 6 cm, body weight 57 $\pm$ 5 kg) and 7 male (age 24 $\pm$ 1 yrs, height 184 $\pm$ 7 cm, body weight 83 $\pm$ 7 kg). Height and body weight were measured after physical examination and body mass index (BMI) and body surface area (BSA) was calculated. Resting heart rate was measured and 12 lead ECG and echocardiography (ECHO) were made.

The ECG findings are the following in the folk dancers' group: 16 normal ECG, 8 incomplete RBBB and 1 LV hypertrophy; in the control group 5 normal, 3 RBBB and 3 LV hypertrophy, and also 5 hypertrophy of the left atrium and 2 short PR interval. The morphological parameters of the heart (LV and right ventricle (RV) and diastolic (EDD) and end systolic diameters (ESD), sizes of the left and right atria, ejection fraction, diameters of the septum and the posterior wall in systole and in diastole, LV mass (g) were measured, and LV and RV EDD/BSA, LV and RV ESD/BSA, LV mass/body weight, LV mass/BSA were calculated) with ECHO. Significant differences were found in the following parameters: LV EDD/BSA, LV mass/body weight and LV mass/BSA showed significantly increased values in the control group. A separate examination of the females

revealed that only LV EDD/BSA was increased in the control female group. Among the males the LV EDD, diameters of the septum in systole and in diastole, LV mass and LV mass/BSA were increased in the control group. The morphological parameters of the heart correspond to the effects of the increased training in the control group. The ECG and morphological changes of the heart in both groups are due to the physiological adaptation. Further studies are required to examine the changes in dynamic parameters.

#### P100-03

### Sports injury frequency and type A behavior pattern in long distance male runners

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**Keywords:** behavior pattern, long distance running, sport injuries

Type A behavior pattern (TABP) is defined as a constellation of physiological and behavioral characteristics including such features as enhanced aggressiveness, hard driving competitiveness, a chronic sense of time urgency and hostility. Our previous study showed that athletes familiar with sports activity had greater TABP tendencies than subjects who did not lead a physically active life (Oishi et al., 1999 ; Nigorikawa et al., 2000). In case of athletes, Type A individuals might show a disturbance of nerve-muscle coordination or absence of sufficient attention to the circumstances under the training or competition with too much tension or excitement. Therefore, there is a possibility that Type A athletes suffer from higher percentage of injury occurrence compared to non-Type A athletes. However, the relationship between TABP and sports injuries has not been studied fully.

This study investigated the relationship between sports injury frequency and tendencies toward TABP in long distance runners. Subjects were (19.3±1.0 years) a total of 30 long distance male runners belonging to a college club team in Japan. KG's Daily Life Questionnaire (Yamasaki et al., 1992) was used to investigate the tendency of TABP. We defined the injury occurrence as that the runners themselves reported the pain which induced training discontinuance at least one term per a month. Therefore, the injury occurrence was shown once or never per month, and the occurrence was recorded throughout one year. The subjects were divided into two groups; a high frequency injury (HFI) group and a low frequency injury (LFI) group. The subjects who reported over four times during the year were classified into the HFI group. Meanwhile, three times or less were classified into the LFI group. TABP scores and its sub-scores were compared. Our hypothesis was that the Type A runners showed higher occurrences of sports injury than the non-Type A runners.

Most of the results in this study supported our hypothesis, i.e., the HFI group showed higher TABP tendency than the LFI group.

To study the TABP tendency of athletes may be one of the useful methods to prevent sports injuries.

Oishi et al (1999). *Applied Human Science* 18: 101-108

Nigorikawa et al (2000). *Jpn J Phys Fitness and Sports Med* 49: 549-560

Yamasaki et al (1992). *J Type A Behavior Pattern* 3(1): 33-45

#### P100-04

### Effects of a four-week training program on the cardiorespiratory parameters of elite junior swimmers

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**Keywords:** swimming, adaptation, training cycle

The training program of different elite swimmers predicts the performance in a competition. Our experimental model was a four week long mesocycle, in which eight swimmers completed the training program. They were swimming 3 hrs per day/18 hrs a week. At the end of each week we performed a vita-maxima treadmill loading in order to measure the adaptation of their cardio-respiratory system.

We asked the following questions: 1, Does the cardio-respiratory system change and adapt to the working load in four weeks? 2, In which parameters is the adaptation significant? The eight swimmers mean age was 16,12 years, the somatotype was 2,96:1,81:3,75. The body mass was monitored from the beginning of the program, and it did not change during the program. The measurements were completed on the same day of each week, 2 h after the training. We completed the protocol according to Bruce, comparing the following data to each other: VO<sub>2</sub> before the treadmill protocol started, VO<sub>2</sub>max, the heart rate at the beginning, and maximal heart rate, the latency of the anaerobic threshold. Blood pressures and ventilation was also monitored at each load-level change. In the swimming pool the swimmers were tested once a week in a 200 m breaststroke swimming test. First they performed a submaximal (approx. 80%), half an hour later a maximal effort test followed by a blood lactate test.

We found significant differences only in the time of anaerobic threshold, and in the basal heartrate ( $p < 0,05$ ), but the tendencies of the adaptational changes were the same in each parameter, namely the lowest maximal heartrate, the lowest lactate level, the lowest VO<sub>2</sub>max was found in the second week of the training. After the second week each parameter increased and in the fourth week they either reached or exceeded the original levels with a better performance, and with a better aerobic and anaerobic capacity.

#### P100-05

### Ergometer exercise test in children: Responses of normal children to controlled exercise in supine body position

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**Keywords:** children, ergometer exercise, physical working capacity

Exercise tests are an essential part in evaluation of the physical working capacity (PWC) and ventilatory response. The protocols in several studies used the upright body position on the bicycle ergometer. It has been reported that the body position has distinct effects on the ventilatory response and maximal PWC. The aim of our study was to acquire normal values for healthy children for ergometer exercise in the supine body position.

65 boys and 57 girls, aged 7-15 years, participated in the study. All children were volunteers from local schools. Each subject underwent an exercise test using the Godfrey

protocol. The test was performed on a bicycle ergometer (Ergoline Ergometrics 900, Bitz, Germany) in the supine position. The work load was increased every minute until exhaustion with increments depending on the height of the children: 10 W for children less than 120 cm, 15 W for children from 120 to 150 cm, and 20 W for children over 150 cm. Ventilation (VE), Oxygen consumption (VO<sub>2</sub>) and expired CO<sub>2</sub> were measured with a Sensormedics VO<sub>2</sub>max 229 unit.

Many investigators used a variety of cycle ergometer protocols to assess VO<sub>2</sub>max in children and presented values of male subjects between the ages of 9 and 14 years from 39 to 60 ml/kg/min. Mocellin (1976) found a mean VO<sub>2</sub>max of 45 ml/kg/min for boys (6 - 17 years) and 42 to 35 ml/kg/min for girls (6 - 17 years). Our results for VO<sub>2</sub>max do not differ much from these data. However, the maximal PWC is different from other investigators. Klimt (1988) found values from 3,3 to 3,7 W/kg for boys (7 - 18 years), and 2,8 to 3,5 W/kg for girls (7 - 18 years). Bar-or (1986) presents mean values for PWCmax from 2,8 to 3,2 W/kg for girls (7 ±16 years) and 3,4 to 3,8 W/kg for boys (7-16 years) for ergometer exercise in upright body position. We found distinctively lower values for PWCmax in supine body position with 2,1 to 2,6 W/kg for boys and 1,7 to 2,6 W/kg for girls. But only the boys in the age group 9 - 14 years and the girls in the age group 10-12 years reached the necessary heart rate of 190 bpm for exhaustion. Our results suggest not comparing the results of different exercise protocols and exercises in different body positions. However, we are surprised that values of VO<sub>2</sub>max are not so different from other studies compared to the lower values of PWCmax.

Godfrey S (1971). *Clinical Science* 40: 419-43

Rowland T (1993). *Human Kinetics Champaign, IL USA*

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#### P100-06

### Distance covered and motion patterns of Brazilian top soccer players

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**Keywords:** soccer, training

This study was designed to establish reference patterns for total distance covered as well as the different forms of movement based on the positional role in Brazilian professional soccer players.

The sample consisted of 62 professional soccer players 18-35 years old ( $x = 24.3 \pm 4.3$  years old) from São Paulo Futebol Clube. The athletes were divided in five groups: Fullbacks (FBK), wingers (WGR), defensive midfielders (DMF), offensive midfielders (OMF), and strikers (STK). For movement analysis a special computer software was used. ANOVA-one way with the post hoc Scheffé was used to compare distance and frequency of movements RESULTS: total distance covered, OMD, WGR and DMF are those under hardest stress, with 9918.1 ±825.8, 9685.1 ±944.3 and 9498.8 ±709.2 meters, respectively. For jogging, OMF, DMF and WGR with 5422.5±1051.5, 4942.0±652.9 and 4536.7±698.6 meters, respectively - outdistanced strikers, who ran 3638.8 ±170.7 meters on the average during the match. In relation to sprinting, STK and WGR (632.8±191.2 and 619.6±176.5, respectively) ran longer than FBK and OFM (375.8±148.5, 420.0±108.8, respectively)

The results can show that the distance covered in the different movements will highly depend on the positional role

and are relevant in determining the individual training program.

#### P100-07

### Test for the evaluation of the special force in boxing

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**Keywords:** boxing, testing

The objective evaluation of the force of boxing's punches needs sophisticated equipment. Most of the athletes do not have the option to get such an evaluation.

For this evaluation we started a cheap experimentation of a ballistic pendulum device: a pendulum punching bag, an iron frame and an integrated system of photocells and microcomputer. The punching bag is screwed to a disk, soldered at an iron bar. The frame supports the punching bag and it permits a front-rear movement. The photocells, connected to the microcomputer (Globus), are fixed to the frame by 4 bars to record the oscillation pendulum time in a 30° angle. With a trigonometric formula we could transform the time in N. We calculated the frictions through the punching bag oscillation degree in relation to a hammer weight (friction=8%). To value the reliability and the validity of the device, we tested it on a group of 18 boxers, 9 amateurs (age 22±5; height 175±7; weight 71±8) and 9 unprofessional subjects (age 20±2; height 175±6; weight 70±4). They executed on the punching bag 4 jabs and 4 cross punches. We calculated the respective means. The trial was repeated in two succeeding days.

The results of the reliability study show values of r between 0,91 and 0,81 for the both punches valued in the two groups with p<0.01. The study of validity was conducted with Anova one-way and showed superiority of the agonist boxers who had significantly better results related to the amateurs. The cross punch percentage difference was 39% (p<0,01) with passing time 30° of 0,11±0,01vs.0,15±0,03 sec. For the jab, the difference was of 19% (p<0,001) with passing time 30° of 0,17±0,03vs.0,20±0,02 sec. The force of the cross punch was always higher than the jab's, in the amateurs (23%; p<0,003) and in the agonists (34%; p<0,001). The high correlation test-retest shows that our punching bag gives reliable data.

It confirms the different force ability of various level boxers and the difference of jab and cross punches force.

The N values we recorded (max.6532N; min.1091N) are not exactly the same of those obtained with the other machinaries of international studies. Perhaps the cause is the friction, the level of photocells sensibility, and the error max (we didn't calculate). This topic will be our next study.

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J. Atha, M.R. Yeadon, J. Sandover, K. Parsons (1985). *British Medical Journal*, 291, 1756-1757.

#### P100-08

### A model for the identification of talent in 12-year-old netball players

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**Keywords:** netball, talent selection, modelling

The objective of this study was to analyse the existing literature of the game of netball as played at school with



regard to the physical and motor abilities, anthropometrical variables and game specific skills to determine what requirements are needed for achievement. After this a prediction function (selection model) was composed that can serve to distinguish talented twelve-year-old netball players from less talented players in the primary school. The three top twelve-year-old netball teams (N=20) that participated in North West Province, South Africa, twelve-year-old league were used, together with players (N=21) who played social netball. A battery of tests consisting of 10 anthropometrical variables, 12 physical and motor abilities and 6 game specific skills were used. Results indicated that the classification of netball players as talented and less talented is possible and that a prediction function could be useful to identify potential twelve-year-old netball players.

#### P100-09

### Ergometric index to assess the physical performance capacity

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*Keywords: physical performance, ergometric testing*

The aim of this comparative study was to examine the physical performance capacity of different groups of healthy and sick subjects in order to formulate an index that well discriminates among the groups.

The subjects were divided into six groups: (1) Elite athletes (n=79, age 22.8±3.1 years), (2) medical students (n=84, age 20±2.4 years), (3) sedentary adults (n=51, age 44.9±14.2 years), (4) coronary artery disease (CAD) (n=79, age 55.3±9.7 years), (5) diabetes mellitus type II (n=31, age 55.3±9.7 years), (6) recovered from myocardial infarction (n=54, age 56.2±12.5 years). One-minute incremental ramp protocol was used on bicycle ergometer without gas analysis. The predicted maximal workload was calculated according to Wassermann et al. We measured the heart rate, the arterial blood pressure, duration of exercising, and the power output. The oxygen consumption, the relative aerobic capacity (RAC %) and the rate-pressure product (heart rate x systolic blood pressure) were calculated. We introduced an ergometric index calculated by the formula as follows: Ergometric index = maximal power output / (heart rate x systolic blood pressure) x 10<sup>-2</sup>. Maximal power output is given in watts, heart rate in beats per minute and blood pressure in mmHg.

The statistical analysis of the data revealed physiologically minor but statistically significant variations in the relative aerobic capacity among the groups. In contrast, the ergometric index shows both physiologically and statistically significant differences and well discriminates between the well-trained athletes and the others. The values of the groups are as follows: (1): 0.93±0.15, (2): 0.59±0.13, (3): 0.57±0.15, (4): 0.50±0.15, (5): 0.40±0.11, (6): 0.52±0.16 [F=10.51, P>0.0005].

A well-trained athlete produces high maximal power output with lower heart rate and arterial blood pressure than sedentary or sick subjects. Therefore, their ergometric index is big. Consequently, the ergometric index may be used to assess both the effects of athletic training, the physical condition of the healthy subjects, and the progress in cardiopulmonary rehabilitation.

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#### P100-10

### Physical condition and motor abilities of junior football players

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*Keywords: motor abilities, football, reaction time*

The purpose of this study was to examine the physical condition and motor abilities of junior football players in order to test the effects of their training program.

The subjects were 31 boys, 13 years old at the beginning of measurements. All subjects were participating in the examinations voluntarily with written informed consent of their parents. Anthropometrical measurements and recording of the cardio respiratory functions were done in the laboratory. The motor abilities were assessed by a series of static and dynamic motor tests in the gymnasium. All measurements were repeated one year later. Descriptive statistics and ANOVA were used for statistical analysis.

Significant developments were found in the body measures that exceeded the biological maturity. The resting arterial blood pressure and heart rate did not change. In contrast, the vital capacity increased significantly. A slight decrease in the reaction time was found. Both the static and the dynamic motor tests showed significant improvement. The means of maximum static strength of thigh flexors increased from 189.5 kg to 230.29 kg, and that of the extensors from 348.1 kg. The increase in vertical jumping was 3 cm, and in the triple jumps 0.08 m. The time for 25 m zigzag running decreased with 0.36 seconds.

In Hungary, football is the most widespread sport activity. In view of the physiological characteristics and the biological developments of teens, their regular physical training requires special attention. For example, the overtraining in this age may produce more serious consequences than in older age. Therefore, our intention was to control the effects of their training on the body measures and the motor abilities. Our series of measurements proved to be appropriate to follow the development of the physical condition and motor abilities of junior football players. However, our intention is to shorten the interval between two series of measurements to six months.

#### P100-11

### Identification of partial motor typologies and an attempt to achieve total motor typologies with girls

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*Keywords: Eurofit Tests, girls, motor typologies*

This paper is based on designing of the motor typology for urban environment girls. The design has been carried out on the basis of the EUROFIT test results (European Tests for the Evaluation of Psycho-motor Abilities). Until today, many papers have been written, whose approaches were based on the hypothetical base of the component structuring of motor activities and psycho-motor characteristics in humans. The aim of the paper was to identify the partial motor typology and provide an attempt to identify the total motor typology, which in reality exists within the framework of the research motor taxonomy continuum.

For this research, we used a sample of sixty-eight females selected from the girls aged 11 to 15, living and going to school in the central part of the city of Sarajevo, Bosnia and

Herzegovina. For the identification of the psycho-motor characteristics of the subjects, we used six motor tests (EUROFIT). In the data processing methodology, the factor analysis of Alpha Extraction and Varimax Rotation was used; the Hotelling method of the main components; the hierarchy Cluster analysis method, and the discriminative canonic analysis method.

In conclusion the analyses provide a point to the justification of the application of the main component method in profiling the motor abilities of girls and their combination with the use of the Cluster Hierarchy Analysis in the real motor taxonomies. According to the general view, such taxonomy analysis is significant for the identification of theoretic and practical ways of classification of the subjects into homogenous motor groups, which could be a good orientation in sport selection.

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#### P100-12

### **Influence of two endurance training methods (extensive endurance method vs fartlek) on running speed, rate of perceived exertion and metabolism in shuttle run**

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*Keywords: endurance training, fartlek, shuttle run*

Acyclic movements (initial start, sprint and series of sprints) in sports games require a great amount of endurance and speed endurance. In sports games endurance influences speed endurance. An athlete having a greater aerobic capacity recovers more efficiently and tolerates higher work duration and also maintains a higher speed level. The aim of preparation period in sports games is to achieve the highest level of speed and endurance possible. Thus it is important to develop and to use special endurance training methods to obtain an optimal performance level. The aim of this study was to find out which endurance training method gives the most increase in speed, rate of perceived exertion and metabolism in a shuttle run.

16 male sports students (22,5 ± 1,8 years;) finished a five week period of endurance training (extensive endurance method or fartlek). The students were divided into two groups with similar endurance performance. Then one group (TGF n=8) finished a standardized Fartlek training, the other an extensive endurance training (TGE n=8) with a work load at 80% of the 4mmol-IAAT. In every training session bloodlactate, heartrate and rate of perceived exertion were noted. In a pre- and post-test the students were asked to sprint a 15x30 m shuttle run test (3 series with 5 runs and 40 s, 2 min series rest). After every series bloodlactate values and perceived exertion were measured.

Mean sprint time in the shuttle run of the TGE (4,36 ± 0,23 s vs 4,35 ± 0,25 s) remained unchanged. The sprint times of TGF tended to improve (4,47 ± 0,18 s vs 4,41 ± 0,17 s). There was no statistical difference between the two groups (p = 0,45) nor in pre-post-testing (p = 0,13). Blood lactate values decreased in TGE (7,03 ± 2,11 mmol/l vs 6,83 ± 2,83 mmol/l) and TGF (8,22 ± 2,48 mmol/l vs 7,21 ± 2,28 mmol/l).

There was also no statistical difference between TG and pre-post testing. Throughout the series there was a highly significant increase in blood lactate concentration of both TGs (p < 0,001). The rate of perceived exertion decreased in both groups highly significantly (TGE: 15,8 ± 1,6 RPE vs 15,1 ± 1,4 RPE; TGF: 16,8 ± 1,8 RPE vs 15,6 ± 1,5 RPE, p=0,001). The results do not show a significant difference in running speed and metabolism of both trainings methods in the shuttle run. Definit tendency of data point to fartlek having a greater influence on running speed and metabolism than ext. endurance training methods. Both training methods show a clear influence on the rate of perceived exertion.

#### P100-13

### **Diagnosis of talent in football by testing special coordinative performance-preconditions**

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*Keywords: soccer, testing, talent selection*

For the determination of a talent, it is necessary to measure specific performance-relevant factors. Especially for biomotor abilities, many tests were generated. The significance of special coordinative performance-preconditions in sports games is postulated (Roth 1998, Kröger & Roth 1999). Therefore the importance of their diagnosis is explained. A testbattery was developed, existing four single tests. Every single test contains a basic skill (passing, ball-controlling, dribbling, shooting) and has to be executed under precision- and timepressure (according to the analysis-raster of Neumaier & Mechling 1994). Moreover every single test is valid in substance and favours both-legged execution. The available results show a considerable selectivity of the tests. The study was realized in co-operation with FV Mittelrhein, as part of the DFB Talent Promotion Program, with 10 to 17 years old football players.

In the next research step, the validity will be proven in an empirical study (three "talentgroups" - football, gamesport, individualsport, and three medium-level groups - football, gamesport, individualsport -). It is supposed, that gamesporttalents reach better results than medium-level footballplayers (special coordinative abilities vs. skills) and individualsporttalents (special coordinative abilities vs. general coordinative abilities).

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## P100-14

**Seated shotput performance and triceps brachii fiber type composition**

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**Keywords:** *fiber type, shot put, m. triceps brachii*

Skeletal muscles of both the upper and the lower body are activated during the shot put (Herman 1962). However, the contribution of individual muscles to the performance of this event remains largely unknown. Triceps brachii is the main elbow extensor during the last phase of the shot put. In order to investigate the contribution of triceps brachii fiber type composition to the upper body shot put performance we used a new test: the one arm seated shot put.

Thirteen male physical education students (age 22yrs, body height 184cm, body weight 85kg), were selected to participate in the study upon their shot-put performance, after a 5-week period of shot-put technique instruction. At the completion of this training period they performed a seated shot-put test using their dominant arm. Briefly, a weight-lifting bench, with an adjustable back was fixed in a shot put circle. The back of the bench was adjusted at an angle of 90° to the ground and seat. The distance between the edge of the circle and the back of the seat was 50 cm. Subjects were seated

on this shot put seat with their feet placed on a box, just in front of the seat, in a way that the hips, knees, and ankles were in a straight line parallel to the ground. The non-dominant arm was rested on the chest. Straps were placed around the chest and shoulders. Ten minutes warm-up was allowed including low level running, stretching and one-arm seated shot put with various loads. Subjects performed 3 trials with each of the following shot weights: 1-, 2-, 3-, 4-, 5-, and 6-kg, starting with the lowest load. Muscle biopsies from the long head of the dominant triceps brachii were obtained one week later and analyzed for fiber type composition with ATPase histochemistry.

Triceps brachii % fiber type II area was significantly related to the one arm seated shot put performance regardless of the weight of the implement ( $r>0.60$ ,  $p<0.05$ ).

Results of the present study suggest that a high percentage of type II fibers in triceps brachii is an important factor to the upper body shot put performance, at least for medium-trained subjects. Furthermore, based on these data, it is reasonable to assume that the use of the light implement (e.g. 1-kg) allowed for higher movement velocity, resulting in a closer relationship between the fast twitch fibers and upper body shot put performance (Aagaard & Andersen 1998).

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**Poster Session****Physiology 1****P10P**

## P10P-01

**Loss of force induced by high extracellular K<sup>+</sup> - effect of temperature, lactic acid and b2-agonist in rat soleus muscle**

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**Keywords:** *muscle fatigue, extracellular potassium, protection*

During exercise, loss of K<sup>+</sup> from active muscles causing high extracellular K<sup>+</sup> concentration ([K<sup>+</sup>]<sub>o</sub>) has been proposed to contribute to muscle fatigue by reducing muscle excitability. Apart from high [K<sup>+</sup>]<sub>o</sub>, intensive exercise is also accompanied by increased muscle temperature, lactic acidosis and an increase in circulating catecholamines. The present study was undertaken to determine the combined effect of temperature elevation, lactic acid and catecholamine on force in muscles depressed by increased [K<sup>+</sup>]<sub>o</sub>.

Intact soleus (slow-twitch) muscles from 4-wk-old Wistar rats were mounted on force transducers for isometric contractions in oxygenated Krebs Ringer bicarbonate buffer and stimulated tetanically every 10 min with 0.2 ms pulses at 90 Hz for 2 s. The specific b2-agonist salbutamol (10<sup>-5</sup> M) was used to simulate the actions of catecholamines. Results from force recordings are expressed in percent of control force being the force at 4 mM K<sup>+</sup> at the corresponding temperature. Control force was 431±7 mN at 35 °C and 413±6 mN at 30 °C.

In all experiments, control force at 4 mM K<sup>+</sup> was initially determined at 35 and at 30 °C. Muscles were then exposed to 11 mM K<sup>+</sup> at 30 °C, which reduced force to 16±4 % of control force. Temperature elevation, L-lactic acid and salbutamol were either introduced in a stepwise fashion or simultaneously. In stepwise introduction, temperature

elevation to 35 °C restored force to 35±5 % of control force. 10 mM L-lactic acid further restored force to 52±3 % of control force and salbutamol, additionally, restored force to 87±2 % of control force. Simultaneous introduction of temperature elevation, L-lactic acid and salbutamol immediately restored force from 16±4 % to 97±1% of the control levels. After 80 min incubation at 35 °C, however, force had decreased to 76±7 % reaching the same level as the muscles exposed to the stepwise introduction, ( $P>0.43$ ).

The present study suggests that elevation of temperature protects muscles against the depressing actions of exercise-induced hyperkalemia. Thus, warm-up before engaging in vigorous exercise could improve the resistance of muscles to fatigue resulting from elevated [K<sup>+</sup>]<sub>o</sub>. Furthermore, the study shows that the protective effect of temperature elevation can be added to the protective effects of lactic acidosis and stimulation with catecholamine. Hence, an exercise scenario emerges in which loss of force induced by increased [K<sup>+</sup>]<sub>o</sub> is counteracted by the simultaneous elevation of muscle temperature, lactic acidosis and presence of catecholamines.

## P10P-02

**Energy expenditure in cross country skiing: spirometry in relation to 3D topographical analysis**

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**Keywords:** *energy expenditure, cross-country skiing, 3D topographical analysis*

When oxygen uptake (VO<sub>2</sub>) and respiratory quotient (RQ) are measured by portable spirometers during physical activity,

parameters influencing the energy expenditure such as temperature, wind and topographical profile are represented in the values. The use of GPS-technologies in addition to portable spirometer allows calculating the energy expenditure in relation to 3D topographical analysis.

Five athletes of international junior level of Nordic Combined took part in the study. These athletes had to run a cross country skiing track of 3,6 km with race-specific intensity. The following parameters were recorded simultaneously: heartrate, ventilatory parameters, distance, altitude and skating velocity. Blood samples were taken before and after the run for the analysis of lactate. Energy expenditure was determined breath by breath by indirect calorimetry. The results give information about the relation between energy expenditure and 3D topographical values. For getting more details about the reaction of physiological parameters to changes in track profile, the slope for specific parts of the track was calculated.

The results show that VO<sub>2</sub> is significantly related to the slope ( $r=0,45$ ;  $p<0,05$ ). During climbing VO<sub>2</sub> and RQ increase. At descent RQ still goes up as a result of coping with anaerobic load, whereas VO<sub>2</sub> decreases time-lagged. Different athletes show specific development of VO<sub>2</sub> and RQ during climbing. The behavior of these parameters gives information about the aerobic and anaerobic portions of energy expenditure. The results show that 3D terrain analysis is an appropriate method in addition to the determination of the energy expenditure in endurance diagnostics.

The analysis of slope combined with values of RQ and VO<sub>2</sub> gives details about the metabolism at specific parts of the track. As it is not possible to measure lactate continuously during physical activity, the study offers a very good method for determining changes of the metabolism in relation to track profile. So a better "tuning" of training load in endurance sports with frequent changes in altitude is possible.

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#### P10P-03

### The effects of exercise on myocardial blood flow in trained and untrained subjects - in vivo studies using PET

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**Keywords:** exercise, myocardium, blood flow

The effects of exercise on blood flow have been widely studied. Currently there is still a lack of studies which consider the effects of acute exercise and endurance training on myocardial blood flow (MBF) during exercise in humans. Thus, the purpose of the present study was to apply bicycle exercise to positron emission tomography (PET) measurements and to investigate the effects of endurance training on MBF at rest and during acute exercise.

Seven endurance trained (ET) and seven untrained (UT) male subjects volunteered for the study. MBF was measured at rest and during two different bicycle exercise loads: the first exercise intensity was quantitatively the same (ABS) for both groups (150 Watts) and the second load (REL) was proportionately the same (70 % Wmax). MBF was measured using a positron emission tomography (PET) and [15O] H<sub>2</sub>O as tracer. Heart rate and blood pressure were recorded and blood samples for blood glucose and lactate determination were taken at rest and during both exercise loads.

Blood lactate concentration was significantly higher in the UT group during both exercise loads compared to ET. In contrast, blood glucose concentration was unchanged in both groups. At rest MBF was the same in both groups ( $p=0,48$ ). However, during ABS MBF was significantly lower in ET than in UT ( $p=0,05$ ) but was statistically the same during REL ( $p=0,48$ ). When MBF was corrected with a rate-pressure-product (RPP) to correspond the same workload done by the heart, MBF was unchanged throughout the experiment ( $p=0,58$ ).

According to the results of the present study endurance trained subjects have lower absolute myocardial blood flow during quantitatively similar submaximal exercise (150 W) which could be explained by the lower work (RPP) done by the heart. However, at rest and during proportionally similar exercise intensity (70 % Wmax) absolute MBF seemed to be similar between trained and untrained subjects. These findings disagree with the results by Heiss et al. (1976) who found lower myocardial blood flow during submaximal bicycle exercise in endurance trained compared to untrained subjects. Therefore, further studies during exercise at different intensities are still needed.

#### P10P-04

### Influence of running distance on Ca<sup>2+</sup> accumulation and muscle damage in humans

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**Keywords:** exercise, muscle damage, calcium

It is well known that long-distance running may lead to damage, soreness and reduced function in the muscles involved in the activity. The degree of muscle damage can be assessed by the amount of intracellular enzymes, such as creatine kinase (CK) or lactate dehydrogenase (LDH), released to the blood. The increases of the plasma levels of these enzymes have been shown to relate to running distance. Increases in intracellular Ca<sup>++</sup> have been suggested to be important in the early phase of the development of muscle damage and recently, Ca<sup>++</sup> accumulation was found in vastus lateralis muscles from humans following 100 km running. In the present study we investigated the occurrence of muscle damage and Ca<sup>++</sup> accumulation at two different running distances (10 and 20 km).

24 healthy young men and women participated in running 10 (n=13) or 20 (n=11) km. Muscle biopsies, from vastus lateralis, as well as blood samples were collected prior to and immediately after the run and in the following days. Biopsies were analysed for Ca<sup>++</sup> content and plasma CK and LDH levels were measured in the blood samples. Maximal voluntary isometric force (MVC) were measured in leg and hand before, immediately following the run, at day 1,2,3, 1 week and 2 weeks post run.

We found that the Ca<sup>++</sup> content in muscles biopsies increased during both running distances (10 km:  $15 \pm 8$  %,  $P=0,12$ , 20 km:  $33 \pm 7$  %,  $P<0,001$ ). The Ca<sup>++</sup> content was still significantly higher than pre-levels at 4 hours and at 48 hours after the 20 km run ( $P<0,01$ ). The concentration of LDH and CK in plasma increased following both running distances, the increases being significantly greater after 20 than after 10 km running,  $P<0,05$  (LDH),  $P<0,05$  (CK). LDH peak values were seen immediately after running and CK peak values were seen at day 1. The values returned to control level within 1-2 weeks after running.

The observed increases in plasma LDH and CK levels following long distance running indicate the occurrence of cellular damage, which increases with running distance (20 km > 10 km). Furthermore, accumulation of Ca<sup>++</sup> in muscle cells seems to increase with running distance, when comparing 10 and 20 km runners.

In conclusion, we found that the degree of muscle damage depends on running distances, and that a significant Ca<sup>++</sup> accumulation in muscle lasting for several days occurs after running a distance of only 20 km.

#### P10P-05

### **Lactate threshold and anaerobic metabolism, but not peak VO<sub>2</sub> or muscle buffer capacity is associated with endurance performance at peak VO<sub>2</sub> intensity**

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*Keywords: aerobic fitness, endurance performance, buffer capacity*

The ability to maintain a high power output during exercise is an important attribute in a number of athletic activities. The purpose of this study was to determine the relationship between total work completed during an endurance test (time to fatigue at peak VO<sub>2</sub> intensity) and muscle buffer capacity, aerobic fitness and anaerobic metabolism.

Seventeen active, but not well-trained females (mean ± SD: age 19 ± 1 y, mass 60.4 ± 9.6 kg, peak VO<sub>2</sub> 2.23 ± .41 L·min<sup>-1</sup>) participated in this study. Tests consisted of a graded exercise test (GXT) to determine peak VO<sub>2</sub> and lactate threshold (LT), followed two days later by an endurance test (ET). Capillary blood was sampled at the end of each stage of the GXT and before and after the ET. Muscle biopsies (vastus lateralis) were taken immediately before and after the ET.

There were significant changes in [ATP], [PCr], muscle [La<sup>-</sup>], [H<sup>+</sup>], blood [La<sup>-</sup>] and [H<sup>+</sup>] after the ET. There were significant correlations between the ET and LT ( $r=0.78$ ,  $p<0.05$ ), anaerobic ATP yield ( $r=0.61$ ,  $p<0.05$ ), change in [PCr] ( $r=0.69$ ,  $p<0.05$ ), muscle [H<sup>+</sup>] ( $r=0.57$ ,  $p<0.05$ ) and blood [H<sup>+</sup>] ( $r=0.54$ ,  $p<0.05$ ). There were no significant correlations between the ET and muscle buffer capacity in-vitro ( $r=0.18$ ,  $p>0.05$ ), peak VO<sub>2</sub> (L·min<sup>-1</sup>), ( $r=0.27$ ,  $p>0.05$ ), muscle [La<sup>-</sup>] ( $r=0.41$ ,  $p>0.05$ ), blood [La<sup>-</sup>] ( $r=0.09$ ,  $p>0.05$ ) or anaerobic ATP yield per s ( $r=0.09$ ,  $p>0.05$ ).

These results provide support for previous findings identifying the importance of a good LT to maintain high-intensity exercise, however differ in that the association between peak VO<sub>2</sub> and high-intensity cycling performance was not significant. This suggests peripheral rather than central oxygen supply characteristics may be more important for maintaining power output at peak VO<sub>2</sub> intensity. In contrast to our previous findings, where we identified a relationship between muscle buffer capacity and RSA 1, there was little relationship between muscle buffer capacity and work completed during the ET. A greater endurance performance was also associated with a greater anaerobic yield of ATP, as well as the ability to breakdown a large amount of PCr. It is likely that the greater anaerobic yield of ATP was the result of cycling for longer, as endurance time was not associated with anaerobic ATP yield per second.

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#### P10P-06

### **Prior heavy exercise speeds VO<sub>2</sub> kinetics during heavy arm cranking exercise performed above the level of the heart**

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*Keywords: VO<sub>2</sub> kinetics, prior exercise, arm exercise*

It has been reported that blood flow and, by implication, O<sub>2</sub> delivery to the working muscles is compromised when gravitational assistance is attenuated, for example during cycle exercise performed in the supine position (Koga et al. 1999) or during arm exercise performed above the level of the heart (Hughson et al. 1996). Gerbino et al. (1996) suggested that the metabolic acidosis resulting from the performance of prior heavy exercise may increase vasodilation and lead to an increase in O<sub>2</sub> availability at the onset of subsequent exercise. Therefore, in the present study, we hypothesised that VO<sub>2</sub> kinetics would be faster in the second of two consecutive bouts of heavy arm crank exercise performed above the level of the heart.

Six male subjects (mean (SD) age: 21.3 (0.5) years, weight: 71.3 (4.4) kg, height: 1.80 (0.05) m) completed two consecutive bouts of 6 min heavy arm cranking separated by 6 min recovery. VO<sub>2</sub> was measured on a breath-by-breath basis and VO<sub>2</sub> kinetics was determined with a bi-exponential model from the averaged data derived from the three repetitions. Capillary blood samples were taken from a preheated fingertip in order to determine plasma lactate concentration. Differences were tested for statistical significance using a 2-tailed paired-samples t-test.

The plasma lactate concentration before the start of the second exercise bout was higher than before the first bout (1.3 (0.3) vs. 6.3 (0.5) mmol·l<sup>-1</sup>;  $P<0.05$ ). The amplitude and time delay of the VO<sub>2</sub> fast component were not significantly affected by prior exercise. However, the time constant of the VO<sub>2</sub> fast component was significantly reduced in the second bout (51.8 (13.5) vs. 42.9 (10.9) s;  $P<0.05$ ). No significant differences were observed in the amplitude and the time delay of the VO<sub>2</sub> slow component.

The results of this study demonstrate that prior heavy exercise, which resulted in a metabolic acidosis, caused a significant 17% speeding of the VO<sub>2</sub> fast component response during subsequent heavy arm crank exercise performed above the level of the heart. It therefore appears that in situations in which O<sub>2</sub> delivery to working muscle may be compromised, the performance of prior heavy exercise may enable a speeding of the fast component VO<sub>2</sub> kinetics.

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## P10P-07

**The effects of a 3-week forearm immobilization and training on muscle function and energetics**

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**Keywords:** muscle oxidative capacity, muscle pH, muscle endurance training

The purpose of this study was to determine the effects of a 21-day forearm muscle immobilization and muscle endurance training on the muscle strength and energy metabolism of the forearm muscle.

Twelve healthy males (age: 22.3±1.2yrs, mean±SD) participated in this study. The non-dominant arm was immobilized for 21 days with a cast. The subjects consisted of an immobilized group (I group; n=7), and an immobilization with training group (IT group; n=5). Exercise training consisted of a handgrip exercise at 30% of maximum voluntary contraction (MVC), one contraction every second to exhaustion, twice a week during the period of immobilization. The measurements were conducted before (PRE) and after (POST) the immobilization. MVC, forearm muscle energetics, and grip endurance were measured. Phosphocreatine (PCr), inorganic phosphate (Pi) and pH in the muscle were measured by a <sup>31</sup>P-magnetic resonance spectroscopy. Muscle oxidative capacity was evaluated by the time constant (Tc) for PCr recovery in the finger flexor muscles after submaximal handgrip exercise. A grip endurance test was performed at 30%MVC (adjusted to each MVC) with 1Hz until the subjects were exhausted. After the 21 day forearm immobilization

on MVC was 42.0±3.5 kg and 34.5±3.4 kg (PRE vs POST, p<0.01) for the I-group, and 45.9±5.7 kg and 38.5±8.6 kg (PRE vs POST, p<0.05) for the IT-group.

Tc was significantly prolonged in the I-group (PRE; 34.7±1.76 sec, POST; 61.7±4.46 sec, P<0.05), however, Tc for the IT-group did not change (51.5±2.4 sec and 51.7±4.9 sec). Grip endurance at 30%MVC did not change for the I-group (PRE; 49.3±2.9 sec and POST; 47.5±4.6 sec). However, grip endurance for the IT-group significantly increased (PRE; 47.6±4.8 sec and POST; 56.2±2.9 sec, p<0.05). The decrease in muscle pH at exhaustion during grip endurance test was significantly attenuated for the IT-group (PRE; 6.56±0.13, POST; 6.82±0.11, p<0.05), but did not change for the I-group (PRE; 6.58±0.28, POST; 6.64±0.16).

Although muscle endurance training used in this study could not prevent the decrease in maximal strength, the training improved muscle endurance and prevented the decrease in muscle pH during exercise. The results of this study suggest that muscle endurance training twice a week is effective for preventing a decrease in the muscle oxidative capacity and the decrease in pH from muscle immobilization during exercise.

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## P10P-08

**Excitation-induced calcium influx and skeletal muscle damage**

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**Keywords:** muscle damage, calcium, force recovery

Prolonged or unaccustomed exercise is known to lead to loss of contractile function and muscle cell damage. Loss of cellular Ca<sup>2+</sup> homeostasis may be involved in this process. The aim of this study was to further investigate the role of Ca<sup>2+</sup> uptake in the development of muscle damage and force loss. This was accomplished by examining whether fatiguing stimulation of a certain duration leads to impairment of force recovery and loss of cellular integrity as indicated by increased <sup>45</sup>Ca uptake, sucrose-space and release of LDH measured during recovery.

EDL muscles from 4-wk old rats were stimulated isometrically. A fatiguing protocol with intermittent stimulation at 40 Hz was applied for 0, 15, 30 or 60 minutes. Force and <sup>45</sup>Ca uptake were measured during the stimulation period. After the fatiguing stimulation either force recovery, resting <sup>45</sup>Ca uptake, <sup>14</sup>C-sucrose uptake or LDH release were followed for up to 4 hrs.

During the fatiguing protocol force declined rapidly reaching 8 % of initial force after only 10 min of stimulation. Force development then stayed low during the remaining period of stimulation. <sup>45</sup>Ca-uptake increased from 3- to 6-fold compared to resting muscles during the stimulation period. After cessation of stimulation, resting <sup>45</sup>Ca uptake was significantly increased in muscles stimulated for only 15 min. This uptake progressively increased following 30 and 60 min of fatiguing stimulation. The muscles recover gradually less of their initial force as the stimulation duration increases. Thus stimulation for more than 15 min seriously affects force recovery even though very little force is actually developed beyond 15 minutes of stimulation. Sucrose space and LDH release was significantly increased by 30 and 60 minutes of fatiguing stimulation.

To sum up, fatiguing stimulation leads to severe functional impairment and loss of cellular integrity in rat EDL muscles as indicated by lack of force recovery, increased LDH release, sucrose-space and resting <sup>45</sup>Ca-uptake. When the stimulation period exceeds 15 min the muscles develop very little force, but still take up <sup>45</sup>Ca. This Ca<sup>2+</sup> uptake may be important in eliciting the damage observed after fatiguing stimulation. In conclusion, the observed loss of contractility and cellular integrity seem to be related to stimulation-induced Ca<sup>2+</sup> uptake rather than to mechanical damage of the muscle fibres.

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## P10P-09

**Regional muscle blood flow and lymph flow responses to exercise in trained and untrained men**

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**Keywords:** exercise, lymph flow, muscle blood flow

Endurance exercise training induces major adaptations in the vasculature of working skeletal muscles. Increased capillary supply and higher maximal blood flow result in enhanced muscular performance capacity. It is well known that the

vascular and the lymphatic system function in a close interaction. However, it is not known if the lymphatic system adapts to prolonged endurance exercise training. This study was therefore designed to compare the lymph flow responses during exercise in trained and untrained men.

Six trained (years of training  $9 \pm 4$ ) and four untrained men cycled 45 minutes at same relative intensity (53% of maximal aerobic power) and the same cadence (75rpm). Blood flow was measured as disappearance rate of  $^{133}\text{Xe}$  and lymph flow as disappearance rate of  $^{99\text{mTc}}\text{-HSA}$ . Both tracers were injected in the same injection into the vastus lateralis muscles bilaterally. The radioactivity at the injection site was monitored by a gamma-camera before, frequently during, and after the cycling. Disappearance rate of albumin and xenon were calculated for each monitoring interval, and were expressed as percentage clearance per minute ( $\% \text{ min}^{-1}$ ). The correction for the physical decay of  $^{99\text{mTc}}$  and  $^{133}\text{Xe}$  and also the background subtraction were made. Each leg was considered as an individual observation.

The absolute exercise intensity was 40% higher in the trained ( $177 \pm 21 \text{ W}$ ) than in the untrained ( $125 \pm 17 \text{ W}$ ) subjects. Measured blood flow response almost paralleled the difference in the absolute exercise intensity, being 60% higher in the trained than the untrained men. Despite the differences in blood flow, there was no difference in the disappearance rate constant of  $^{99\text{mTc}}\text{-HSA}$  during the exercise between trained and untrained men.

Endurance exercise at the same relative intensity induced remarkable differences in the regional blood flow, but no differences in the lymph flow of trained and untrained men. Because the frequency and the relative power of the muscle contractions were the same in both groups, the results suggest that these are the factors rather than blood flow which determine the muscle lymph flow response to exercise. These results suggest that prolonged endurance exercise training does not induce functional adaptations in the skeletal muscle's lymphatic system.

#### P10P-10

### Flow- and volume measurements of two different spiroergometers

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**Keywords:** *spiroergometry, flow-volume*

The use of automated spiroergometers in clinical work and in exercise studies is common. They are important diagnostic tools for patients but also for athletes. Peer reviewed validity and reliability studies should be available from all these systems, unfortunately that is the case only for few spiroergometers. The purpose of this study was to compare the flow- and volume results of two different spiroergometers, the SensorMedics Vmax29 (VM) which is meant for laboratory use and the portable Cortex Metamax 3B (MM) which can be used also in field conditions.

In the first experiment, Vmax29 (CA, Yorba Linda, USA) and Metamax 3B (Leipzig, Germany) were connected to the Portable Metabolic Simulator (Jaeger, Germany) for flow- and volume comparison. The ventilation rates of the simulator were preset to 10, 20, 40, 60 and 80 times  $\text{l} \times \text{min}^{-1}$ . With those ventilation rates the simulator produced VE's of 20, 40, 80, 120 and  $160 \text{ l} \times \text{min}^{-1}$ . The flow meters of the VM and the MM were calibrated with the same 3 l calibration pump before each test. The measurement order was randomly assigned. The results of the VM and MM were corrected to correspond the ambient conditions. In the second experiment, forced expired measurements (PEF,

FVC and FEV1) were performed with 21 healthy subjects in a randomized order.

The 1 minute tidal volume mean difference between the VM and the MM with ventilation of 20 and  $40 \text{ l} \times \text{min}^{-1}$  was 3.7 % and 1.4 %, respectively. With higher ventilation rates the differences were between 0.7 to 0 %. The mean differences of the forced expired measurements (PEF, FVC and FEV1) with 21 subjects were 7.9 %, 5.5 % and 8.0 % for the VM and the MM, respectively. The results with the Jaeger metabolic simulator showed that the tidal volume differences were the highest with the volumes under  $80 \text{ l} \times \text{min}^{-1}$ . PEF, FVC and FEV1 measured with the VM were 5-8 % higher than Metamax 3B results. The difference can be partly explained by the different flow- and volume units. MM expressed them in ATPS conditions and VM in BTPS conditions. Correction of this effect explained 2 % of the difference.

In conclusion, this study showed that there is need for device to show differences in the flow- and volume results of these two spiroergometers.

#### P10P-11

### Effect of warm-up duration on 30 s all-out cycling sprint

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**Keywords:** *performance, warm-up, muscle temperature*

It has been proposed that active warm-up may alter metabolic responses during exercise and this was associated with elevations in muscle temperature. However, how long one has to actively warm-up before any significant improvement in the subsequent 30-s sprint has not been fully elucidated. The purpose of this study was to compare the effect of different warm-up duration on subsequent 30-s performance.

Following a familiarisation session, twelve cyclists and triathletes performed an incremental step test for determination of  $\text{VO}_{2\text{max}}$ . On subsequent visits to the lab, and in random order, subjects performed a 30-s sprint following either no warm-up (WUPno), 4-minute (WUP4) or 20-minute (WUP20) warm-up at 40%  $\text{VO}_{2\text{max}}$ . Performance measures included total work, average and peak power. Peak  $\text{VO}_2$ , total  $\text{VO}_2$ , blood lactate concentration ( $[\text{La}]$ ) and pH, rectal and muscle temperature were also measured.

WUP20 elicited an improved 30-s sprint effort compared to no warm-up. Total work (kJ) during the 30-s sprint was significantly greater after WUP20 when compared with WUP4 and WUPno ( $22734 \pm 3560 > 22419 \pm 3831 = 21299 \pm 3190$ ;  $p < 0.05$ ). Similar results were reported for peak power. Both muscle and rectal temperature were not significantly different between trials at rest. The 4-minute warm-up was too short to see any increase in the core and muscle temperature, however core and muscle temperature were significantly higher ( $p < 0.05$ ) in the WUP20 compared to WUPno ( $38.2 \text{ v } 37.2$ ;  $37.3 \text{ v } 33.8^\circ\text{C}$  respectively). Pre and post warm-up blood lactate were  $1.08 \pm 0.24 \text{ v } 1.81 \pm 0.58 \text{ mM}$  and  $1.0 \pm 0.0 \text{ v } 1.9 \pm 0.3 \text{ mM}$  for WUP4 and WUP20 respectively. Similar pattern was recorded for blood pH values.

The results of this study indicate that 30-s sprint performance is significantly improved following WUP20 (40%  $\text{VO}_{2\text{max}}$ ) compared with WUPno. The improved performance appears to be attributable to significantly higher core and muscle temperature, which has previously been reported to have a direct positive correlation to the relative work rate.

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2. Saltin, B. et al. (1968) *J Appl Physiol.* 25: 679-688

## P10P-12

**Macroscopic adjustment response (length and thickness) of the patellar tendon after strength training****García-Manso Juan, Sarmiento Lourdes, Vázquez Iban**

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*Keywords: isometric contraction, patellar tendon, macroscopy*

This paper reports an empirical study carried out in order to analyse, by means of ultrasonography, the macroscopic adjustment response (length and thickness) of the patellar tendon after a strength training with and without vibratory stimulus (V and NV groups respectively).

The subjects of this research, sixteen adult Physical Education students (11m and 5f) aged  $25 \pm 4$  years, were hardly trained. They underwent a training session, for six weeks (three times a week), which entailed keeping an isometric contraction of the quadriceps muscle. The vibratory stimulus given to the V group (8: 6m and 2f) was of 30Hz in the NEMES Bosco-System platform. The control variables were evaluated both at the beginning and at the end of the training session.

The Friedman and Mann-Whitney U tests were used for the statistical analysis. The results obtained, clearly show that there is an increase in the length and a decrease in the thickness of the patellar tendon in both groups, and that there are no significant differences between them.

The main conclusion reached is that the isometric contraction training, with or without vibration, represents a suitable stimulus to modify the macroscopic structure of the patellar tendon. The increase in the maximum strength was of 1-RM in the present study.

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## P10P-13

**Decrease of body weight estimated by water depth****Onodera Sho, Yamaguchi Hidetaka, Takahashi Kouki, Amaoka Hiroshi, Uorai Baik, Yamazaki Ken, Ishimoto Yasuko, Kosaka Taeko, Nose Yuka, Nishimura Kazuki, Nakanishi Youhei, Nishimura Masahiro, Yoshioka Akira, Miyachi Motohiko, Hara Hideki**

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*Keywords: water depth, body height, body weight*

It is well known that body weight decreases in water. It is also known that the ratio and quantity of decreased body weight depend on the cubit volume of body and specific gravity of water. Previous studies reported that it was mere conjecture to relate water level to body position (like a knee joint). If it deals with water level as a functional equation of a ratio of body height, we hypothesize that it could demand an answer of a ratio of individual decrease. Therefore, we clarify the relationship of % body weight and % body height in the water.

Twenty-two males and five females volunteered for this study. Mean values and standard deviation of body height, body weight, age and % body fat were  $168.6 \pm 6.5$ cm,  $61.4 \pm 8.4$ kg, and  $23.2 \pm 2.8$ yr and  $19.8 \pm 2.3$ %, respectively.

Water depth was measured at eight positions (lateral malleolus, center of leg, lateral condyle, and center of thigh, greater trochanter, xiphoid process, axilla and mental protuberance). Water and room temperature were 30°C. The specific gravity of water was 0.99. Body weight was detected by a spring scale connected with a swing, soaking in water. Water levels were adjusted by the quantity of water adding the water, in a water tank (200 x 200 x depth 250cm). Each body weight (mean $\pm$ SD) in the water was  $59.1 \pm 8.1$ kg (lateral malleolus),  $56.5 \pm 7.9$  (center of leg),  $52.6 \pm 7.5$  (lateral condyle),  $46.9 \pm 7.2$  (center of thigh),  $36.7 \pm 6.8$  (greater trochanter),  $16.9 \pm 2.4$  (xiphoid process),  $10.5 \pm 2.5$  (axilla) and  $4.1 \pm 1.3$  (mental protuberance), respectively. Values of % body height and % body weight for the lateral malleolus were (2.5%, 96.2%), center of leg (14.1%, 91.9%), lateral condyle (25.7%, 85.5%), center of thigh (36.7%, 76.2%), greater trochanter (47.8%, 59.4%), xiphoid process (57.3%, 45.5%), axilla (69.0%, 27.5%), the mental protuberance (74.4%, 16.9%). It had significant correlation between %body height and %body weight. It succeeded in the following functional equation:  $y = 98.9 - 0.121x - 0.012x^2$  ( $y$ =% body weight,  $x$ =% body height,  $r = 0.999$ ).

These results suggest that body weight in the water could be estimated using the relation of % body height (water depth) and % body weight.

## P10P-14

**Acid base balance after maximal exercise in 10 - 11 year-old trained boys: Comparison with adults****Szczesna-Kaczmarek Anna, Ziemann Ewa, Kaczmarek-Kusznierewicz Przybysawa, Grzywacz Tomasz**

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*Keywords: children, maximal exercise, acidosis*

The development of metabolic pathway in children and the metabolic responses during exercise have not been well known and documented. Up to now our knowledge about skeletal muscle metabolism in children is based on a small number of muscle biopsy studies conducted more than 25 years ago (Erikson and Saltin, 1974). The researches reported small activity of muscle glycolytic enzymes in children proportional to ages. The purpose of this stage of the study was to describe the maximal level of lactic acid in blood after maximal work in 10-11 years boys training football and mechanisms of defence against acid-base abnormalities and comparison with the same parameters in adults.

Boys performed maximal cycloergometric work - 30 s Wingate Test. During maximal exercise, we measured maximal power (PP), mean power (MP), total work (TW) and compared with adult young man. Before work, 4 min and 15 min after work we measured parameters of acid-base balance and concentration of  $\text{Na}^+$ ,  $\text{K}^+$ ,  $\text{Cl}^-$  in blood. PP in children was equal 92,8 % and 84,8 % of values measured in untrained and trained man, respectively. Concentration of blood lactic acid in children after work was about 3,5 mmol/l - 5,1 mmol/l, whereas in man about 8,5 mmol/l - 11,5 mmol/l. It was very interesting that there were no differences between  $\text{HCO}_3^-$  and BE levels in children and adults (concentrations of  $\text{HCO}_3^-$  about 12,5 mmol/l - 13,5 mmol/l and BE - 14,6 mmol/l to - 16,8 mmol/l). But surprising differences were in children and in adults after the same pattern of work between values of anionic gap (AG). The explanation of these results is difficult and we ought to continue the investigations in this problem.

The major finding of the present experiments is that total work performed by children is less correlated with lactate



concentration than in adults ( $r=0.89$  and  $r=0.22$  in adults and children respectively) high intensity of work in children results a smaller increase in lactic acid concentration than in young adults. The CO<sub>2</sub> cost of exercise increased from low to high intensity in adults, but this cost was independent of work intensity in children. Children store less CO<sub>2</sub> during exercise than adults. It may be due to less adipose tissue and haemoglobin concentrations.

Erikson, B.O., Saltin, B. (1974) *Acta Ped. Belg.* 28 (suppl.) 257-65

## P10P-15

### Height, weight, BMI and skinfold thickness measured in 677 Italian children as factors for detecting overweight and obesity

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**Keywords:** children, BMI, skinfold thickness

Nowadays there is a great deal of public concern regarding the health status of children because of a lack of movement and unbalanced diets which are leading to illnesses such as obesity, which is associated with several later appearing chronic health conditions. Therefore, diagnosis, treatment and especially prevention of obesity are a major health issue. Several papers have been published in order to identify valid and reliable indicators for overweight and obesity, such as BMI (body mass index), skinfold thickness, waist circumference, etc. They are among the most common measurements in body composition methods. However, the

validity of BMI and skinfold thickness as predictors of overweight and obesity in children is controversial. Our survey aims to detect the changes in physical growth and motor abilities during five years of primary school education. In this paper we focus on BMI and skinfold thickness measures in a population of Italian children.

677 Italian children aged on average 6.5 years were chosen as a target of our survey. Height, weight and four skinfold thicknesses were measured.

The BMI and skinfold thickness mean values were always higher in females than males, although differences were not statistically significant. This might be an early indication of the higher percentage of body fat usually found in women. When our results were compared to the latest Italian growth charts, we found that BMI was quite similar. However, in our study, both males and females were heavier and taller than Italian children of the same age. We considered the thresholds of BMI for overweight and obesity in Italian children according to Cacciari et al (2002). In our data, the level of overweight was found at the 86<sup>th</sup> and 76<sup>th</sup> percentile in females and males respectively. Whereas the level of obesity was found at the 99<sup>th</sup> and at the 97<sup>th</sup> percentile respectively in females and males.

When the data of 5 years are collected and gathered we might be able to give a contribution to determine the levels of BMI and skinfold thickness for a more appropriate classification of overweight and obese children.

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Rolland-Cachera MF et al (2002). *Int J Obes Relat Metab Disord*, 26 (12): 1610-16

## Poster Session

### Physiology 2

### P10Q

## P10Q-01

### Age-related modifications in neuromuscular control during isometric constant-force sustained contractions in healthy women

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**Keywords:** EMG, aging, neuromuscular control

The aim of this study was to investigate the neuromuscular control differences between arm and leg muscles in young and older women, adopting the simultaneous measure of surface electromyography (sEMG), muscle force (torque) and force fluctuations (steadiness) during sustained constant force isometric contractions.

Eight young ( $24.2 \pm 4.2$  years mean  $\pm$  S.D.) and 8 old ( $70.6 \pm 2.6$  years) women participated in this study. The sEMG signals from the biceps brachii (BB) and the vastus lateralis (VL) were recorded with a linear array of 4 electrodes. An isokinetic dynamometer was used to measure the elbow flexion and knee extension isometric torques of the dominant limb. Subjects performed 3 maximal voluntary contractions (MVC) and 3 isometric constant-force contractions at 20, 50, and 80% MVC. SEMG variables of interest were: the normalized slopes of the median frequency (MDF) of the sEMG power spectrum, the root mean square (RMS) and the muscle conduction velocity (CV). Force parameters were the MVC torque and the coefficient of variation of the force

fluctuation (COV). A repeated-measures ANOVA was used to compare the two groups of subjects ( $p < 0.05$ ; with Bonferroni correction where appropriate). No age related differences were observed between the two muscle groups in any of the considered parameters. Older exhibited lower

MVC values in both muscle groups (Knee,  $97.13 \pm 19.36$  Nm in older and  $125.25 \pm 23.35$  Nm in young; Elbow,  $39.88 \pm 8.44$  Nm in older and  $54 \pm 7.78$  Nm in young). The COV was greater in older subjects only at 80%MVC for both arm and leg and increased in both young and older subjects with the level of force. The MDF slope was significantly smaller in older subjects only at 80% MVC for BB and the VL and the rate of decay increased with the force level. CV data mirrored those of MDF.

In spite of the morphological changes documented in literature (1), in the present study no differences were found between arm and leg muscles with regard to neuromuscular control in older women. Differences between young and older individuals were observed only during high intensity isometric contraction as demonstrated by the higher fluctuations of force and by the modification in both MDF and CV in the older subjects. The general loss of strength, associated to a slowing in the muscle properties, could be an important determinant of functional capability of older people.

Grimby G, Danneskiold-Samsøe B, Hvid K, Saltin B (1982) *Acta Physiol Scand* 115:125-134

## P10Q-02

**Muscle recruitment patterns during exercise: response to short term high-fat feeding, epinephrine infusion, and single-leg exhaustive exercise**

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**Keywords:** EMG, fatigue

Muscle recruitment patterns during exercise in response to various interventions designed to alter the sensation of fatigue, including: epinephrine (epi) infusion during low intensity exercise (Trial 1); ingestion of a short term high-fat diet (Trial 2) and exhaustive single leg exercise (Trial 3) were examined.

In 3 separate trials, electromyography (EMG) activity of the vastus lateralis was measured. EMG data was divided into 5 s epochs and normalized against a maximal voluntary isometric contraction (MVIC). The integrated electromyography (IEMG) and mean percentile frequency shifts (MPFS) were expressed as a % of MVIC. In Trial 1, 13 cyclists were randomly assigned to 2 groups, and performed 2x90 min cycle trials. Group 1 cycled at 68% VO<sub>2</sub> max (saline infusion) and at 34% VO<sub>2</sub> max (epi infusion). Group 2 cycled at 34% VO<sub>2</sub> max on both occasions with either saline or epi infusion. In Trial 2, 5 cyclists consumed in random order either a high carbohydrate or high fat diet for 6 days. On day 7 subjects performed a 1hr cycle at 63% PPO and ingested a high CHO diet before performing a 100km TT on day 8. In Trial 3, 5 trained subjects performed exhaustive single leg cycling (Leg 1), followed by the same exercise protocol on the previously rested leg (Leg 2).

In Trial 1, epi infusion during low intensity exercise did not alter IEMG or MPFS. In Trial 2, high-fat feeding followed by CHO loading did not result in any significant differences in IEMG or MPFS during either steady-state exercise or 100km TT. In Trial 3, there was no significant difference in time to exhaustion between Legs 1 and 2. However, from the outset IEMG was significantly greater for Leg 2 than Leg 1 ( $p < 0.05$ ). MPFS increased significantly in Leg 1 ( $p < 0.05$ ), and was significantly different in Leg 1 compared to Leg 2.

Changes in substrate metabolism, heart rate and metabolic response to exercise secondary, to epi infusion and dietary manipulation, are not associated with changes in muscle recruitment. Conversely, fatiguing single leg exercise alters muscle recruitment from the outset of exercise, in the previously rested leg. These data provide some evidence of central programming of muscle recruitment, secondary to the sensation of fatigue in the first leg. The CNS therefore responds using prior experience and afferent feedback by increasing neural drive resulting in an increase in muscle recruitment, thereby maintaining the required workload.

## P10Q-03

**Energy cost of walking on a treadmill varies with body weight unloading and speed in both healthy young and older women**

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**Keywords:** energy cost, treadmill walking, body weight unloading

The aim of this investigation was to explore the variation of energy cost of treadmill walking, expressed both per unit of

time (WECt) and unit of distance (WECd), at different percentages of BWU and speeds in both healthy young and older women.

With ethics committee approval, 6 young ( $26 \pm 3$  years; mean  $\pm$  S.D.) and 6 older women ( $70 \pm 4$  years) volunteered for the study. All participants were in good physical condition with no signs or symptoms of cardiovascular, respiratory or neuromuscular disease, nor were they taking any pharmacological agent. Prior to the final experimental session, all subjects were familiarised with the experimental protocol on two separate days. Participants were asked to walk on the treadmill at three percentages of BWU (0%, 20% and 40%) and three self-selected speeds (comfortable, fast and slow), which were previously measured in the open field by measuring the time to walk along a 6 m pathway. Oxygen consumption was measured by a telemetric device (Cosmed K4, Italy) and WECt (J/kg/min) and WECd (J/kg/m) were calculated. Statistical comparisons of these parameters between groups (young and older) and different conditions (speed and percentage of unloading) were carried out by ANOVA for repeated measures, followed by Student's t-tests with Bonferroni adjustment where appropriate. Significance levels were set at  $P < 0.05$ .

There was a significant effect of speed and percentage of BWU on both WECt and WECd in both young and older groups. However, there were no significant differences between the two groups in WECt, WECd and walking speeds.

The results of this study indicate that 1) at any given speed, WECt and WECd decrease as the percentage of BWU increases; 2) at any given percentage of BWU, WECt is similar at slow and comfortable speed and higher at fast speed; 3) at any given percentage of BWU, the WECd is minimum at the most comfortable speed and is higher at fast or slow speed; 4) WECt at 40% of BWU is similar to that measured at the comfortable speed with no BWU.

Older women could therefore be trained by walking on a treadmill at 40% of BWU, thus achieving higher speeds than they would do in normal gravity conditions without increasing their effort. The higher speed of movement would represent a stimulus to the neuromuscular system to respond with an increase in walking speed, which will be carried over in the open field.

## P10Q-04

**Acute interleukin-6 administration enhances plasma IL-1RA, IL-10 and cortisol in humans**

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**Keywords:** leukocytes, cytokines, interleukin-6

Several cytokines increase in the plasma during and after exercise. Interleukin (IL)-6 increases up to 100 fold and is elevated before any other cytokines are measured. Recently it was demonstrated that the contracting limb is the source of IL-6 during exercise, and our group has found that IL-6 enhances lipolysis in humans. During infections IL-6 plays a central role in initiating anti-inflammatory cytokine production and in controlling leukocyte trafficking. The major purpose of the present study was to test the hypothesis, that plasma IL-6 concentrations, as can be evoked by exercise, induces an anti-inflammatory environment in humans.

Twelve active males were recruited to participate in the study. Subjects were divided into two groups receiving either recombinant human (rh) IL-6 or saline infusion for 3 hours. Blood samples were obtained before, during, and after the

infusion. Lymphocyte and neutrophil concentrations were determined in the blood, and IL-6, IL-1ra, IL-10, cortisol, adrenaline and C-reactive protein (CRP) were determined in the plasma.

Plasma IL-6 levels during the 3 hours rhIL-6 infusion were approximately 140 pg ml<sup>-1</sup>, corresponding to the levels obtained during strenuous exercise. Plasma adrenaline, plasma TNF- $\alpha$ , heart rate, mean arterial pressure and temperature were not affected by IL-6 infusion. The anti-inflammatory cytokines IL-1ra and IL-10 significantly increased ( $P < 0.05$ ) during the rhIL-6 infusion. Also plasma CRP increased ( $P < 0.05$ ) in response to rhIL-6 infusion. Plasma cortisol increased ( $P < 0.05$ ) during rhIL-6 infusion to reach plasma levels similar to exercise. The number of circulating neutrophils increased ( $P < 0.05$ ) during the rhIL-6 infusion, peaking two hours into the infusion ( $13.1 \pm 0.8$  Bill L<sup>-1</sup>), compared with control ( $5.5 \pm 0.7$  Bill L<sup>-1</sup>). The next day circulating neutrophils were back to pre-infusion numbers. The lymphocyte number declined ( $P < 0.05$ ) during the rhIL-6 infusion.

This study demonstrates that physiological concentrations of IL-6 induces an anti-inflammatory rather than an inflammatory response in humans, and that IL-6, independently of TNF- $\alpha$ , enhances the levels of not only IL-1ra, but also IL-10. Furthermore, IL-6 induces increase in cortisol and consequently neutrocytosis and late lymphopenia to the same magnitude and with the same kinetic as during exercise, suggesting that muscle-derived IL-6 has a central role in exercise-induced leukocyte trafficking.

#### P10Q-05

### **Muscle metabolism in mitochondrial myopathy patients in comparison to sedentary individuals and endurance athletes.**

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**Keywords:** *exercise, mitochondrial myopathy, magnetic resonance spectroscopy*

Mitochondrial disease is characterized by exercise intolerance, raised lactic acid production and muscle pain. This study investigated muscle metabolism in active and sedentary healthy individuals and patients with mitochondrial myopathy. The study objective was to outline metabolic markers for exercise intolerance and possible avenues for therapeutic intervention.

Eighteen participants were divided into three groups: patients with mitochondrial myopathy (MX), sedentary healthy controls (SC) and trained healthy controls (TC). SC and MX groups were matched for activity. <sup>31</sup>P spectra were acquired from the vastus lateralis muscle group. Spectra were then analyzed for PCr, ADP, pH, free intracellular magnesium ([Mg<sup>2+</sup>]<sub>i</sub>), and phosphorylation potential. All values were analyzed using a one way factorial ANOVA and a post hoc t-test.

Vastus PCr, [Mg<sup>2+</sup>]<sub>i</sub> and phosphorylation potential were similar between sedentary ( $40.76 \pm 2.88$ ,  $0.20 \pm 0.07$ ,  $0.17 \pm 0.04$ ) and trained healthy controls ( $39.42 \pm 4.35$ ,  $0.19 \pm 0.05$ ,  $0.15 \pm 0.11$ ). Vastus PCr, [Mg<sup>2+</sup>]<sub>i</sub> and phosphorylation potential were significantly lower in the MX group ( $26.83 \pm 6.06$ ,  $0.14 \pm 0.02$ ,  $0.05 \pm 0.02$ ) compared to the SC ( $p < 0.01$ ) and TC ( $p < 0.01$ ) groups. No difference in muscle cell pH was detected between the MX ( $7.06 \pm 0.04$ ) group and the other groups, TC ( $7.09 \pm 0.02$ ) showed elevated muscle pH compared to SC ( $7.04 \pm 0.02$ ) ( $p < 0.05$ ).

The decreased PCr content in MX suggests an impaired mitochondrial sensitivity and energy transfer within the muscle cell. The significant reduction in cellular [Mg<sup>2+</sup>]<sub>i</sub> in the MX group may indicate inefficient handling of Ca<sup>2+</sup> and an lack of [Mg<sup>2+</sup>]<sub>i</sub> for mitochondrial enzyme co-activation. Increased exercise activity in health need not alter muscle PCr or phosphorylation potential but can achieve altered proton efflux from the muscle cell, possibly through an up regulation of the H<sup>+</sup>/Na<sup>+</sup> antiporter. Exercise training of patients with mitochondrial myopathy may also up regulate this anti porter providing benefits for removal of exercise-generated protons. In summary, there are significant metabolic changes in patients suffering from mitochondrial myopathy independent of physical activity. Creatine and/or magnesium supplementation may improve exercise tolerance and recovery.

#### P10Q-06

### **No significant correlation between three somatotype indices and aerobic power in elite runners**

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**Keywords:** *aerobic power, running, somatotype*

Anthropometric profile assessment is one of the well-known talent identification methods. Somatotyping as a nonaggressive and reliable technique plays an important role in gross predicting running performance in youth athletes. The purpose of our study was the determination of correlation coefficients of three somatotypic indices (ectomorphy, mesomorphy, and endomorphy values) and (1) maximal oxygen consumption (VO<sub>2</sub>max), (2) oxygen consumption at lactate threshold (VO<sub>2</sub>LT).

Somatotypes of twelve elite, male runners [age: 21.91 yrs (5.12); body mass: 63.8 kg (5.18); height: 175 cm (17.45)] were measured using the Heath-Carter somatotyping method. The mean somatotype value of the group was 1: 2: 3.5 (ectomesomorphic pattern). Then, in stage two, VO<sub>2</sub>max & VO<sub>2</sub>LT was tested using Balke, and Conconi field test protocols, respectively (mean VO<sub>2</sub>max: 62 ml/kg/min; mean VO<sub>2</sub>LT: 45.4 ml/kg/min). As statistical method, we used Pearson's correlation method to measure correlation coefficients (r) between each somatotypic indices and two aerobic fitness determinants.

Our results show that there is no significant correlation between ectomorphy value and VO<sub>2</sub>max ( $r = -0.17$ ) & ectomorphy value and VO<sub>2</sub>LT ( $r = -0.22$ ). Also, no significant correlation coefficients were found between mesomorphy values & VO<sub>2</sub>max ( $r = 0.2$ ), mesomorphy values & VO<sub>2</sub>LT ( $r = 0.24$ ). At last, we observed no relationship between endomorphy & VO<sub>2</sub>max ( $r = -0.31$ ) and endomorphy & VO<sub>2</sub>LT ( $r = 0.18$ ).

Although, some studies show high negative correlation between body weight, fat mass, body fat percent, and aerobic power in many sport disciplines including endurance running, a result of this study seems to be that there is no significant correlation (negative or positive) between elite long & middle distance runners' VO<sub>2</sub>max and VO<sub>2</sub>LT and three somatotypic indices values. Therefore, as a practical issue in talent identification programs, it is better to consider this anthropometric variable as a less & limited predictive measure in future athletic performance.

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*Jansen Peter (2001). Lactate Threshold Training.*

## P10Q-07

**Development of the aerobic fitness in elite young orienteers****Faff Jerzy, Ladyga Maria, Starczewska-Czapowska Janina**

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*Keywords: physical fitness, orienteering, aerobic capacity*

The aim of the study was to estimate the age-dependent changes in the indices of the aerobic fitness of young male and female elite orienteers aged 16 to 26 and 15 to 29 years, respectively.

Two methods of the analysis of the results were employed. In the first method, the results were obtained from the subjects examined three to seven times at one-year intervals. The changes in the values of the studied indices were calculated for each pair of the consecutive years. The results were analysed in six age groups each of which consisted of eight to 13 female and ten to 18 male. Mean values of the individual annual changes in the indices were calculated depending on the age of the examined subjects. In the second method, the orienteers were divided into four age groups each consisting of ten males and six females who, during the period from 1990 to 2000, exhibited the highest maximal oxygen uptake; in this case, the differences between the means obtained for each group were analysed. The test exercise consisted of running until exhaustion on a mechanical treadmill with the workload being increased by 2 km per hour every five minutes. During the exercise, the following indices were recorded: speed of the run ( $V$ ), heart rate (HR), pulmonary ventilation ( $VE$ ), oxygen uptake ( $VO_2$ ), and lactate concentration (LA) in the arterialised blood. Both the maximal (max) and at the lactate threshold (OBLA) values of the examined indices were estimated. In addition, the economy of running (RE) was calculated.

It was found that the subjects body mass increased or tended to increase until the age of 23 years. The 16-17-year-old males demonstrated elevation of the absolute values of  $VO_{2max}$ , and the values of OBLA increased or tended to increase in the males aged 16-19 years. In the 16-18-year-old boys and the 15-17-year-old girls improving in the RE was detected. No significant alterations in the values of the remaining indices could be demonstrated.

The obtained results indicate that in male and female athletes representing such a typical endurance sport as orienteering, elevation of the values of the aerobic fitness indices with increasing age of the subjects is relatively early suppressed

## P10Q-08

**Blood transit time heterogeneity is associated to oxygen extraction in exercising human skeletal muscle****Kalliokoski Kari, Knuuti Juhani, Nuutila Pirjo**

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*Keywords: muscle, blood flow, oxygen consumption*

The purpose of the present study was to investigate 1) whether exercise changes muscle blood transit time heterogeneity in humans *in vivo* and 2) whether blood transit time heterogeneity correlates to muscle oxygen extraction. Ten healthy men participated in this study.

Muscle blood flow, blood volume, and oxygen uptake were measured using positron emission tomography at rest and during low-intensity intermittent isometric exercise. Blood transit time was calculated voxel by voxel from muscle blood flow measured using  $^{15}O$ -water and muscle blood volume measured using  $^{15}O$ -CO. Muscle oxygen extraction was calculated by non-linear fitting from dynamic  $^{15}O$ -O<sub>2</sub> data. Fractal analysis was used for calculation of heterogeneity of blood flow, blood volume, and blood transit time. Exercise increased muscle oxygen uptake, blood flow, oxygen extraction fraction, and blood volume.

Concomitantly, exercise shortened blood transit time to one fourth from the resting value and decreased macrovascular blood transit time heterogeneity. Fractal dimension of the blood transit time was not different between the exercising and resting muscle. Therefore, the estimated heterogeneity of blood transit time in the microvascular units was also lower in the exercising than in the resting muscle. Macrovascular blood transit time heterogeneity correlated poorly with the oxygen extraction fraction in the resting muscle but highly inversely in the exercising muscle.

These results show that low-intensity exercise increases oxygen extraction, shortens blood transit time, and decreases its heterogeneity in human skeletal muscle *in vivo*. Findings in correlation analyses suggest that less heterogeneous blood transit time associates to better muscle oxygen extraction during exercise. More studies with higher exercise intensities are needed to confirm whether blood transit time heterogeneity is truly a limiting factor for muscle oxygen extraction.

## P10Q-09

**Influence of blood lactate concentrations on the anaerobic peak power****Santos Amândio M, Barbosa J, Fontes Ribeiro CA**

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*Keywords: anaerobic, peak power, blood lactate*

Documentation about the development of short-term power output in young people is scarce compared with the abundant literature describing the development of aerobic power. The majority of studies has used the Wingate Anaerobic Test (WAnT) to determine peak and mean power but it has been shown that the resistance typically applied may not be optimal for eliciting true peak power. The Force Velocity test (FVT) circumvents this problem by determining individual force-velocity curves from which optimal peak power (PP<sub>opt</sub>) may be derived. The aim of this study was to verify the relationship between blood lactate concentrations and the anaerobic peak power obtained through an adapted protocol where the load (optimal load achieved on FVT) is constant during all sprints.

Written informed consent to participate was obtained from 20 university male students (age:  $19.4 \pm 1.5$  yrs; body mass:  $71.9 \pm 5.5$  kg; stature:  $174.2 \pm 4.0$  cm, and sum of triceps and subscapular skinfolds:  $39.6 \pm 10.4$  mm). The FVT consisted of 4 to 6 sprints (on a Monark 824E cycle ergometer) lasting 5 to 8 s against a range of randomly presented resistances (75 to 155 g·kg<sup>-1</sup>). PP<sub>opt</sub> was determined according to the procedures described by Winter et al. (1991). The adapted FVT involves a series of sprints against the constant optimal load obtained on the FVT. Five minutes passive rests were allowed between each sprint. The test was stopped when the power decreased two standard deviations related to the previously PP<sub>opt</sub>. Post-exercise blood lactate concentrations were determined from finger-tip blood samples obtained 5

min after each FVT sprint (during passive recovery) and subsequently analysed using a Lang Photometer LP20.

The number of sprints without peak power decrease realized for each subject varied between 5 to 14 sprints. Post-exercise blood lactates (in mmol·L<sup>-1</sup>) and the PPopt (in watts) during the first 5 sprints were the followings: 1st Sprint:  $2.1 \pm 0.5$  and  $849.4 \pm 143.8$ ; 2nd sprint - and  $854.9 \pm 145.8$ ; - and  $875.7 \pm 145.2$ ; 4 th sprint -  $8.9 \pm 1.2$  and  $887.4 \pm 157.1$ ; 5 th sprint -  $9.9 \pm 1.2$  and  $862.2 \pm 171.2$ . In spite of the increase of lactate concentration after each sprint, the PPopt remained constant, at least during the first 5 sprints. After the 5th sprint there was no relationship between the decrease in PPopt and blood lactate levels. For the same lactate concentrations the beginning of the decrease in PPopt was different among the subjects.

In conclusion, our results suggest that lactate may not affect PPopt values.

### P10Q-10

#### Low frequency fatigue of quadriceps muscle after sustained maximum voluntary contractions

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**Keywords:** fatigue, muscle, electrical stimulation

In humans, low frequency fatigue (LFF) occurs in concentric, isometric and eccentric exercise (Newham et al. 1987; Ratkevicius et al. 1995). Although the mechanism for production of LFF is unknown, both metabolite build-up and elevation in intracellular Ca<sup>2+</sup> concentration as well as muscle mechanical damage have been suggested to play a role in the development of LFF (Newham et al. 1987; Chin et al. 1997).

12 untrained men took part in the study. Before and immediately after the exercise (isometric sustained maximum voluntary contractions with the duration of 60 s were performed at knee joint angles of 90 degrees) and 3, 7 and 15 min following the exercise the contractile properties were tested. The following data were measured: the force of the quadriceps muscle, aroused by electrical stimulation at 1 Hz, 10 Hz, 20 Hz and 50 Hz frequencies (the duration of each electrical stimulation series was 1 s). The contractile force was measured at knee joint angles of 135 degrees and 90 degrees in a randomised way. The ratio of force aroused by electrical stimulation at 20 Hz to 50 Hz was calculated for the evaluation of LFF.

The results have shown that immediately after the exercise there was a significant ( $P < 0.05$ ) decrease in muscle force induced by low (1, 10, 20 Hz) and high (50 Hz) stimulation frequencies (it is not muscle length-dependent) and it did not recover to pre-exercise level 15 min after the end of exercise. During recovery period there was a significant ( $P < 0.05$ ) decrease in the ratio of force aroused by electrical stimulation at 20 Hz to 50 Hz. From 3 min to 15 min during recovery LFF increased significantly ( $P < 0.05$ ) and it is muscle length-dependent, because LFF is more pronounced ( $P < 0.05$ ) in short length than long muscle length.

The LFF observed here may consist of 2 phases: an early, rapid recovery phase (up to 3 min) and a slow recovery phase. There is an increase in LFF during a slow recovery phase and it is more pronounced when LFF is registered at short length.

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### P10Q-11

#### Systemic and "peripheral" effects of exercise training on oxidative metabolism in subjects older than 75 year

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**Keywords:** training, oxidative metabolism, aging

Systemic and "peripheral" effects of a 3-month training program (carried out 3 days a week and including warm-up, aerobics, strength training and cool-down exercises) on oxidative metabolism were evaluated in 7 subjects aged  $78.0 \pm 3.2$  (mean  $\pm$  SD) years.

Incremental exercises to voluntary exhaustion were carried out on a cycloergometer (CYCLO) (in order to detect the effects of training on "systemic" variables for evaluation of oxidative metabolism), and on a leg-extension (LE) machine, in which the relatively small mass of the involved muscles (the quadriceps) should eliminate any cardiovascular limitation to exercise performance. During CYCLO, amongst other measurements, heart rate (HR) and pulmonary O<sub>2</sub> uptake (VO<sub>2</sub>) were determined; values obtained at exhaustion were considered "peak" values. During LE exercise, the subjects carried out 3-min loads at 20%, 40% and 60% of 1 repetition maximum (1RM); HR and Vastus Lateralis surface electromyography (EMG) was recorded, and the root mean square (RMS) of the EMG signal was calculated.

VO<sub>2peak</sub> values increased by ~8% from  $1.42 \pm 0.33$  L/min ( $19.0 \pm 4.65$  ml/kg/min) before training (B) to  $1.53 \pm 0.38$  L/min ( $19.8 \pm 4.9$  ml/kg/min) after training (A;  $p < 0.05$ ). HR<sub>peak</sub> increased from  $130 \pm 14$  in B to  $143 \pm 14$  in A ( $p < 0.005$ ). 1RM and Vastus Lateralis muscle fatigue during exercise at 40% of 1RM (the workload completed by all subjects), evaluated by the slope of the RMS versus time profile, were not affected by training. At exhaustion during LE, HR ( $82 \pm 7$  b/min in B,  $84 \pm 7$  b/min in A; n.s.) was well below the age-predicted maximum, confirming that LE did not represent a significant burden for the cardiovascular system.

The present preliminary results suggest that, in >75 year old subjects, a low-intensity exercise training program positively affect "systemic" variables of evaluation of oxidative metabolism.

### P10Q-12

#### Study of blood lactate kinetics and sprint ability changes during a soccer game

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**Keywords:** lactate, soccer, sprint

The analysis of physiological parameters can provide important information about performance fluctuations during a soccer match. So, this research was carried out in order to determine changes in heart rate (HR) profile, blood lactate kinetics and speed performance in 8 different moments of the game.

Ten Portuguese male soccer junior players were involved in the study. HR was monitored through the whole game (Polar Vantage Nv). Blood lactate samples (by Accusport Boeringer Mannheim) and maximal speed on 20 meters (by Digitest - 1000) were measured in 8 moments of the match: the 1st moment was addressed at rest, before the game start; the 2nd moment between the 13th and the 18th minute of the game; the 3rd moment between the 28th and the 33rd minute; the 4th moment between the 42nd and the 45th minute; before the second part of the match starts a 5th moment was considered; the 6th moment between the 58th and the 63rd minute of the game; the 7th moment included the 73rd to the 78th minute; and finally the 8th period was considered between the 87th and the 90th minute. To compare average HR obtained in both parts of the match a t-test for paired samples was used. Comparison of blood lactate and maximal speed values on the 8 considered moments was made using an ANOVA with repeated measures procedures.

Our results reveal analogous values of average HR between the 1st and the 2nd part of the game. Considering the blood lactate kinetics, our results reveal higher values during the 1st part of the match compared to the 2nd one, although significant differences exists only between the 3rd and the 8th moment. Bearing in mind maximal speed capacity change during the game, our results couldn't find any differences between both of its parts.

Our analysis of blood lactate kinetics suggests a more intense effort during the 1st part of the match compared to the 2nd one, also observed by Bangsbo (1993). Changes in metabolic resources may also have accounted for the reduction in blood lactate concentration during the 2nd part of the game. The maintenance of maximal speed capacity during both parts of the match suggests that high intensity efforts weren't impaired.

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#### P10Q-13

### Influence of prior aerobic load intensity on the heart rate kinetics during intermittent increasing exercise

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**Keywords:** heart rate, prior aerobic load, lactate threshold

The aim of the study was to examine the influence of a prior aerobic load (PAerL) of different intensity on HR kinetics during intermittent exercise with increasing work rate.

A group of physically active young men (n=8), mean age 22.5±2.6 years, volunteered to participate in this study. Their mean body mass was 69.6±9.8 kg and their mean height was 1.77±0.3 m. The subjects performed graded intermittent exercise test on an electrically braked ergometer, while cycling at 70 rpm. The tests consisted of repeated 3 min work and 4 min passive rest intervals. No special warm-up was performed. The duration of the first work period was 4 min, the work load was set at 25 W. Thereafter the WR was increased by 25 W during each consecutive work period. The test was continued until the subjects' HR at the end of work period approached 80% of age predicted maximum (220 - age). The HR was recorded continuously with a Polar HR monitor. The lactate threshold (LT) was indirectly estimated for each subject on the basis of the relationship of HR at 4 min of recovery and WR. The transient responses of HR

during on transition and recovery periods were analysed by adopting the mono-exponential

I function. Each subject completed three intermittent exercise tests: one without PAerL and two after 30 min of PAerL of different intensity (one 25 W lower and the other 25 W higher than LT). The blood lactate concentration was measured before PAerL, at 5th, 10th, 20th and 30th min during PAerL.

To compare the HR parameters between testing conditions (without and after PAerL) the data were normalized to each individual's LT. The HR was elevated at the end of work and recovery at the intensities lower than LT only after PAerL the intensity of which was higher (p<0.05) and caused moderate increase in blood lactate concentration. The HR mean response times were prolonged after heavier PAerL especially at the intensities lower than LT both during work and recovery.

#### P10Q-14

### Effects of water intake on physiological function during the ascent of Mt. Daisen in summer

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**Keywords:** rectal temperature, water intake, urinary electrolytes

The purpose of the present study was to investigate the effects of water intake on physiological function during the ascent of Mt. Daisen (1,710m above sea level) in summer. Temperature and relative humidity during the ascent of Mt. Daisen were 28.2±2.2% and 71.5±6.0% respectively.

Ten males and two females (age: 24±3) volunteered to participate in this experiment. They all had climbed Mt. Daisen at least two or three times. Climbers were divided by their amount of water intake (100ml or 400ml). There were no significant differences between the two subject profile groups. Water intake of 100ml or 400ml used at four resting points (2nd, 990m : 4th, 1158m : 6th, 1367m : 8th, 1583m : top, 1710m). 100ml and 400ml of water are roughly equal to 0.1%, and 0.3% of body weight, respectively. Subjects were evaluated using the rating of perceived exertion (RPE), body weight, heart rate (HR), rectal temperature and urinary electrolytes (Na, K and Cl). After urination, the subjects rested for 30 minutes, and then urine was taken and body weight measured before ascent. HR was monitored every 15 seconds during the ascent. After water intake at the resting point, rectal temperature was measured for 3, 6, 9, 12, 15 minutes. After the measurement of body weight, urine was sampled at the top of Mt. Daisen.

The decrease in body weight found in the of 100ml group reached 0.9kg during the ascent of Mt. Daisen, which was significantly larger than that of the 400ml group. HR of the 100ml group showed a decrease according to ascent, of about 100 beats per min (bpm), while HR of the 400ml group was about 90 beats per min (bpm) at the 6th resting point. Although a significant difference was not shown in rectal temperature between the 100ml group and the 400ml group at the following resting points (6th, 8th, top), the 100ml group showed a tendency higher than the 400ml group. In the 100cc group, urinary potassium (before; 1.6±1.1mEq, after; 10.1±3.4mEq, Means±SD. P<0.05) increased significantly after the ascent of Mt. Daisen.

These results suggest that the water intake for the 100ml group (0.1% of body weight) was insufficient to compensate

for sweat loss during the ascent of Mt. Daisen for three hours in summer.

#### P10Q-15

### **Peculiarities of muscle blood flow and cardiovascular function during sprint workouts**

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*Keywords: adaptation, sprint, cardiovascular function*

It is now well accepted that training is relatively specific to the particular form of exercise used in conditioning. The objective of this study was to reveal the peculiarities in changes of muscle blood flow and indices of cardiac function during the sprint exercise in depending on the type of training.

The subjects of this study were 18 non-sportsmen, 17 sprint-runners and 13 long distance runners. The participants had been investigated by the use of a computerised 12-lead ECG analysis system "Kaunas-Load", venous occlusion plethysmography, tetrapolar reography, cycle ergometry, dynamometry and ergography. The values and changes of calf muscle blood flow, heart rate, arterial blood pressure, stroke volume, cardiac output, the indices of ECG (ST-segment depression, JT interval, ratio JT/RR) were analysed. The differences in muscle recruitment patterns that occur with low-intensity endurance exercise and high-intensity sprint exercise undoubtedly are reflected in various physiological systems (Shephard, 1992; Delp, 1996). We have found that all groups differ in the number of high-sprint exercise repetitions without steep changes of some indices. As example, the changes in ST-segment depression at the beginning and at the end of workout were significant and individual. High quality sprinters have less increases of ST-segment depression and non-sportsmen have the highest changes. We can make the same conclusion from the correlation analysis. If the values of correlation between the changes of muscle blood flow and other indices of cardiovascular function were in the same correspondent level ( $r=0.48-0.64$ ), than after 5th, 6th or 7\* repetition decreased or even changed the sign of correlation. It shows that other physiological mechanisms became more important in performing the task. So not only some indices but also the changes in correlation between the muscle blood flow and cardiovascular indices are valid for predicting the number of repetitions needed for this kind of exercise in training session.

The type of adaptation to exercise has an important role in the reactions of cardiovascular system to sprint exercise. The optimal values of activation of cardiovascular function during the sprint exercise can be determined after evaluation of the type and degree of adaptation.

#### P10Q-16

### **Impact of the regular exercise in elderly people on the balance of type 1 and type 2 cytokines**

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*Keywords: walking, elderly, intracellular cytokines*

Regular exercise training may be an effective method of preventing or retarding impaired immune function in aging

individuals. Strenuous exercise also decreases the percentage of type 1 T cells in the circulation. The purpose of the present study was to test the hypothesis that regular exercise training in elderly people affects the type 1/type 2 balance.

Nine elderly women who train by walking (mean age  $\pm$  standard error,  $63 \pm 1$  yrs,  $VO_{2peak}$   $32.2 \pm 1.0$  ml\*kg<sup>-1</sup>\*min<sup>-1</sup>), twelve age-matched untrained women ( $63 \pm 1$  yrs,  $27.8 \pm 0.9$  ml\*kg<sup>-1</sup>\*min<sup>-1</sup>), and nine young untrained women ( $26 \pm 1$  yrs,  $37.8 \pm 1.3$  ml\*kg<sup>-1</sup>\*min<sup>-1</sup>) participated in the study. We used flow cytometry, which measures the intracellular cytokines (IFN-g, IL-2, and IL-4) in CD4+ and CD8+ T cells, to compare the number of circulating type 1 and type 2 T cells.

The number of CD4+ cells expressing intracellular IFN-g was significantly higher in the elderly trained group than in the young untrained group ( $P < 0.01$ ). The number of CD8+ cells expressing IL-2 was significantly higher in the elderly trained group than in the elderly untrained group ( $P < 0.05$ ). The percentage of CD8+ cells expressing intracellular IL-4 was significantly higher in the young untrained group than in the elderly trained and untrained group ( $P < 0.01$ ). The number of CD8+ cells expressing intracellular IL-4 was also significantly higher in the young untrained group than in the elderly untrained but not in the elderly trained groups ( $P < 0.01$ ) (Fig. 3D). No significant differences were apparent in the IFN-g/IL-4 ratio within CD4+ and CD8+ cells from the three groups.

The major finding of this study was that the IFN-g/IL-4 ratio within T cells was not significantly different between trained elderly women and untrained elderly women. However, the concentration of IL-2 within CD8+ T cells in the peripheral blood was increased in the trained elderly women compared to the untrained elderly women. The results of this study might indicate that the effect of age on the balance of type 1/type 2 T cells was stronger than the effect of physical training.

#### P10Q-17

### **Study of the training load, perception of effort, salivary IgA levels and susceptibility to disease in swimmers during a winter training season**

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*Keywords: immunity, training load, perception of effort*

Sports community believes that during periods of high training loads or after important competitions athletes present higher susceptibility to upper respiratory tract infections (URTI). Recent studies suggest that depression of the immune system may occur in these periods. However, the correlation between immune suppression, the training process and the incidence of URTI episodes is not conclusive (1,2). This study tried to identify possible correlations between the susceptibility to URTI, levels of salivary IgA (sIgA) and training load.

During a winter season, the training load of 46 swimmers was monitored. 23 male athletes with a mean age of  $17.48 \pm 1.86$  and 23 female with a mean age of  $15.74 \pm 1.25$  years old, divided in two groups of 23 elements, based on their competitive level. Half of the sample accessed to the Portuguese National Championships, while the remaining participated only in regional competitions. During the study each athlete received an individual table where weekly registered the number, type and duration of URTI episodes and their perception of effort according to the Cr10 and RTL

scales (3, 4). At 10 moments corresponding to specific periods of the training process saliva samples were collected for the determination of sIgA levels and were asked to fill the STAI, used to control alterations that might be related to anxious states.

The results show that the national level athletes had a significant higher volume (728,478+132,721 versus 626,053+157,124km,  $p=0.021$ ). The perception of effort for the entire sample correlated well with the weekly volume and intensity for the two scales used. Correlation between scales was also significant ( $r=0.952$ ). For the URTI the national group showed a higher number but with no statistical significance except for week 19 where the differences between volume and intensity are also significant and had

been so since week 15. During the study the regional group showed small alterations on sIgA levels with no significant differences between the 1st and last moments; the national group showed significant alterations on IgA levels related to the workload, and exhibited higher levels of IgA at the end of the study associated with a decrease on the training load. No correlation was found between the levels of sIgA and the number of URTI.

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## Poster Session

### Physiology 3

P10R

P10R-01

#### Various haemodynamic parameters in relation to the anaerobic threshold during upright cycle ergometer exercise

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**Keywords:** ECG, vascular unloading, lactate turn point

Non-invasive haemodynamic monitoring using impedance cardiography has been shown to be possible at rest and during exercise. No data has been presented about the relationship of various haemodynamic parameters to the anaerobic threshold during upright cycle ergometry.

Twenty-five moderately trained healthy young male subjects (mean(SD) age: 24(4)yrs, weight: 78(7)kg, height: 182(6)cm) performed an incremental cycle ergometer test in an upright position. Two submaximal markers of energy supply were defined by means of blood lactate concentration (LA): aerobic threshold (AeT): first abrupt increase of LA above resting levels; anaerobic threshold (AnT): second abrupt increase of LA between AeT and maximal workload (Pmax). Non-invasive haemodynamic monitoring was performed at supine position prior the test and during the exercise test using a combination of impedance cardiography and vascular unloading technique to measure stroke volume (SV), cardiac output (CO), systolic blood pressure (BP) and total peripheral resistance index (TPRI) (Task Force@ Monitor, CNSystems, Graz, Austria). The determination of break points in all measured variables was done by means of computer-aided linear regression break point analysis between AeT and Pmax.

Workload (P) and heart rate (HR) at Pmax were 331(35) W and 185(10) min<sup>-1</sup>, respectively. SV was significantly higher; BP and TPRI were significantly lower at supine compared to the upright position at rest. SV, BP, CO increased, TPRI decreased steadily from resting values to Pmax. BP showed a plateau at workload above AnT. A break point was observed in measured variables in most of the subjects. One-way ANOVA revealed no statistical significant difference ( $P>0.05$ ) of workload at AnT (242(29) W,  $n=25$ ) and at workload of the breakpoint of SV (247(41) W,  $n=19$ ), CO (249(40) W,  $n=18$ ), TPRI (232(37) W,  $n=22$ ) and BP (239(36) W,  $n=25$ ). Significant correlations ( $P<0.001$ ) were observed between workload at AnT and at workload of the breakpoint of SV ( $r=0.756$ ), CO ( $r=0.800$ ), TPRI ( $r=0.646$ ) and BP ( $r=0.626$ ).

We conclude that there is a strong relationship between the anaerobic threshold and various haemodynamic variables. Non-invasive haemodynamic monitoring using impedance electrocardiography and vascular unloading technique seems to be useful for application during upright cycle ergometry.

P10R-02

#### Relationship between leptin, total antioxidant status and subcutaneous fatness in endurance and resistance trained male athletes

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**Keywords:** exercise, leptin, total antioxidant status

Circulating leptin is low in trained subjects and closely related to body fat content. Intense physical activity lowers adiposity but is suggested to increase free radical production. We investigated whether there is a relationship between total antioxidant status (TAS) and leptin and whether such a relationship is modulated by the amount of subcutaneous fatness and by the mode of activity (endurance vs. resistance) of trained male athletes.

20 endurance and 17 resistance trained athletes were studied. Subcutaneous fat (SAT) and its distribution was measured by means of the optical device lipometer at 15 body sites (SAT-layers; from 1-neck to 15-calf) on the right side of the body. 15 SAT-layers were summed to calculate SAT. Blood samples were determined for leptin and TAS.

In all athletes, estimates of adiposity were correlated to leptin and to TAS. Factor analysis for measured SAT-layers extracted two factors. Factor 1 (F1) can be considered as extremity fatness, whereas factor 2 (F2) includes SAT-layers from the trunk. In the whole group, leptin was significantly correlated to SAT, F1 and F2 (all  $p<0.0001$ ). Leptin was related to TAS ( $r=0.30$ ,  $p=0.04$ ), and TAS correlated significantly with the BMI ( $p=0.04$ ), SAT ( $p=0.006$ ), F1 ( $p=0.007$ ) and F2 ( $p=0.02$ ). After adjustment for adiposity, leptin was not longer related to TAS. When athletes were considered separately, there was a trend for a relationship between leptin and TAS ( $r=0.40$ ,  $p=0.06$ ) but only in RT-athletes. In RT-athletes, TAS was significantly correlated to SAT, F1 and F2 (all  $p<0.05$ ). Such correlations were not found in ET-athletes. Stepwise regression revealed SAT as the main determinant for leptin (adj.  $R^2=0.53$ ,  $p<0.0001$ ).



The results suggest that subcutaneous fatness is the main determinant for leptin. However, any relationship between TAS and leptin is modulated by the degree of fatness suggesting that leptin is not independently linked to antioxidative capacity. Nevertheless, the fact that the relationship between TAS and subcutaneous fatness is not the same in both groups of athletes indicates that the mode of training (resistance vs. endurance) might play a role in antioxidative capacity. At present it is not clear whether an increase in TAS reflects a protective response against an increase in the production of free radicals or 'simply' reflects a state of oxidative stress.

#### P10R-03

### Physiological responses and ratings of perceived exertion utilizing the OMNI 0-10 scale in children aged 9 to 12

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*Keywords: children, perceived exertion, physiological response*

We studied the physiological responses of 2 modes of exercise and 3 different ratings of perceived exertion (RPE), central (C), peripheral (P) and an overall (O) via OMNI 0-10 and a modified OMNI 0-10 scale to ascertain whether children could accurately rate their RPE at different intensities during the two modalities.

Twenty (N = 20) boys and girls (ages 9 - 12 yrs) were randomly assigned to 2 groups of 10. Each group was comprised of 5 girls and 5 boys. Two VO<sub>2</sub>max tests were administered, one on a treadmill (TM) the other on an electronically braked cycle ergometer (CE). During the TM test, children walked at 4.8 km.h<sup>-1</sup> for 1 min, with a speed increase to 8.0 km.h<sup>-1</sup> at min 2, both at 0% grade. During min 3, the speed was maintained at 8.0 km.h<sup>-1</sup>, while the grade increased by 2.5% every 2 min until exhaustion. During CE children pedaled at 60 rpm at 0 resistance for the first minute followed by an increase of 10, 15 or 20 Watts (W) every min thereafter depending on the child's height. During both tests respiratory gas exchange measures were recorded via SensorMedics V-Max 29 metabolic cart, heart rate (HR) was monitored via telemetry (Polar NV, Port Washington, NY) and RPE-C, P, and O ratings were determined. A modified OMNI 0-10 scale was used for the RPE on the TM (substituting a runner for a biker).

Statistical analysis revealed significant differences for sex (p<0.001) between the TM and CE exercise. There were significant differences (N = 20; p<0.001) for VO<sub>2</sub>max, ml.kg<sup>-1</sup>.min<sup>-1</sup> and VEBTPS l.min<sup>-1</sup>. In addition, there were significant differences (p<0.001) in VO<sub>2</sub> ml.kg<sup>-1</sup>.min<sup>-1</sup> for sex and mode and for all 3 RPE measurements on the TM vs. the CE. Correlations were computed for the 3 RPE on CE and TM and between sexes ranging from r = -0.21 to 0.92. Girls consistently rated their RPE more homogeneously compared to boys on TM and CE.

The results revealed that VO<sub>2</sub>max was higher on the TM than on CE (approximately 10% higher) and that children, similar to adults, can accurately rate their perception of exertion at different exercise intensities.

#### P10R-04

### Neuromuscular adjustments during and after an exhaustive stretch shortening cycle exercise

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*Keywords: muscle fatigue, neuromuscular adjustments, eccentric contraction*

The functional defects induced by eccentric muscle actions have been revealed in most studies by exercises, such as maximal isometric or passive stretch-reflex tests, which differed clearly from the fatiguing exercise. The purpose of this study was to compare in the same and submaximal stretch shortening cycle (SSC) task the potential immediate neuromuscular adjustments to fatigue (during the course of the SSC exercise) to the delayed ones (2 days later).

SSC fatigue of the leg extensor muscles was induced in 8 subjects by an exhaustive rebound exercise on a sledge ergometer. The exercise stopped at exhaustion, i.e. after a maximal number of series of 40 rebounds to a submaximal (80%) rebound height with inter-series recovery of 3 min. Ground reaction forces were recorded in parallel with surface EMG activity from the soleus (SOL), gastrocnemius medialis (GAM) and vastus medialis (VM) muscles. The recordings were averaged over 15 successive rebounds at the beginning (PRE) and at the end (POST) of the SSC exercise, and two days (D2) later. The EMG activity was quantified for 3 phases: the last 100 ms of preactivation, the expected stretch-reflex period (M1), and the intermediate (0 to M1) phase. Maximal isometric strength test (ISOM) was also performed.

The SSC exercise induced large acute (-31% ± 15) and delayed (-15% ± 17) plantarflexion force reductions in ISOM (p<.01). Subjective pain sensation peaked for both quadriceps and triceps surae muscle groups on D2 (p<.01). For the rebounds, SOL preactivation and its subsequent activation from 0 to M1 were increased both in POST and D2. These results contrasted with the absence of change for the M1 period. Similar changes were observed for the VM EMG. The respective GAM EMG changes were limited to the preactivation phase in D2.

These findings reveal similar acute and delayed neuromuscular adjustments to fatigue. The increased EMG activity during both preactivation and (0 to M1) phases is attributed to central attempts of muscle fatigue compensation. The contrasting EMG stability during the subsequent M1 period supports the hypothesis of a peripheral reflex inhibition. This could result from a disfacilitation due to intrafusal damaged fibers as well as from increased inhibitions from Ib and/or sensitized small muscle afferents. On D2, the Ib hypothesis is attenuated by the significant reduction of the ground impact peak whereas the influence of small muscle afferents is supported by severe muscle soreness.

#### P10R-05

### Physiological criteria of exercise energy cost

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*Keywords: pulse sums, oxygen requirement, energy cost*

Heart rate is one of the most frequently used parameters for practical purposes. However, this parameter reflects changes only in a narrow range of aerobic exercise that does not

exceed the maximum values of oxygen consumption. Much more information in this respect is provided by such parameters as the exercise pulse cost derived from the analysis of heart rate change dynamics during work and recovery.

26 well-trained male swimmers, middle-distance runners and speed skaters (ages 18-24, height 162-186 cm, body mass 62-83 kg), ranging from club to international level, volunteered to take part in the study. All subjects performed 5 all-out tests - at 10, 30, 60, 120 and 360 second duration without a preliminary warm-up. Heart rate data were collected using monitor Polar S-610.

The work pulse sums increase linearly along with the exercise duration increase. The post-exercise pulse sums ramp rapidly in short duration exercise and reach their maximum at 2 min duration time, decreasing with longer duration. The exercise pulse cost that equals the sum of work pulse sum and recovery pulse sum parameters in short duration exercise depends primarily on the change of recovery pulse sum; however, by the sixth minute of the exercise, contributions made by the work pulse sum and the recovery pulse sum to the exercise pulse cost value become approximately equal. This is different for the pulse cost rates: these values decrease exponentially as the exercise duration goes up. The described correlations of exercise pulse cost values repeat closely existing correlations identified for the values of oxygen requirement and exercise energy cost.

The pulse sums parameters derived based on the study of pulse rate kinetics during work and recovery provide invaluable information about exercise energy expenditures and can be used as objective criteria for quantifying physical exercise.

#### P10R-06

### Repeated prolonged exercise during four days increases sleeping heart rate and metabolic rate

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**Keywords:** *room calorimeter, catecholamines*

The aim of this study was to determine whether prolonged exercise repeated during 4 days was associated with increases in sleeping metabolic rate (SMR) and heart rate (HR) during the night following each day of exercise.

Eleven young untrained men exercised 5 hours daily during 4 days at moderate intensity on a treadmill and cycle ergometer alternately. Subjects spent one night for adaptation, the night before the exercise period (control, C) and the 4 nights following exercise days (N1 to N4) in room calorimeters. Sleep HR, SMR and respiratory quotient (RQ) were analysed from 0000 to 0600h. Every morning, before the exercise bouts, free plasma epinephrine (E) and norepinephrine (NE) levels were determined.

All sleep HR values after exercise were significantly higher than C level ( $59 \pm 1$  vs  $52 \pm 1$  bpm,  $p < 0.001$ ) (means  $\pm$  SEM). SMR increased by  $12.5 \pm 1.3$  % from C to N2 ( $p < 0.001$ ) and then was maintained at a plateau up to N4. RQ decreased from C ( $0.833 \pm 0.009$ ) to N2 ( $0.798 \pm 0.005$ ) ( $p < 0.001$ ) and then plateaued. Plasma NE levels were higher after the night following each day of exercise and peaked on N2 ( $504 \pm 34$  vs  $305 \pm 15$  pg.ml<sup>-1</sup> on C,  $p < 0.001$ ), whereas no significant variations were found for E. Variations of HR, between C and N2 ( $p = 0.05$ ,  $r^2 = 0.38$ ), and N3 and N4

( $p = 0.02$ ,  $r^2 = 0.46$ ) were positively correlated with variations of SMR. No significant relationships were found between plasma NE changes and either SMR or HR variations.

These results demonstrated that prolonged exercise repeated during 4 days induced an increase in metabolic rate during the post-exercise nights with concomitant increase in fat oxidation reflected by the RQ decrease. The increased plasma NE level at the end of the night could result from an increased sympathetic activity during prolonged exercise which may have persisted up to the end of the night and may be responsible for these responses.

#### P10R-07

### Effect of two training modalities on exercise tolerance in the elderly

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**Keywords:** *elderly, training, central and peripheral adaptations*

Regular physical activity has the ability to contrast the degenerative effects of ageing on exercise tolerance, yet, the contribution of central vs peripheral adaptations remains debated. The study was aimed to gain insight into the contribution of central and peripheral adaptations to the recovery of exercise capacity in the elderly by comparing the effects of a training program performed on a cycle and arm ergometer, characterized by the involvement of muscle masses of different sizes and with a different potential to elicit central adaptations to exercise.

Seventeen non-smoking healthy sedentaries (12 M, 5 F;  $66.2 \pm 4.4$  yr;  $72.9 \pm 8.8$  kg) were randomly divided into two groups assigned either to an arm cranking (ARM) or to a cycloergometry (CYC) 12-week supervised training (30 min, 3 times/week). Before and after training, subjects performed an incremental test on the ergometer on which they trained (homeo-ergometer) and on the other ergometer (hetero-ergometer) (Technogym, Italy). A 5-min warm-up (40 W for ARM and 50 W for CYC) was followed by a stepwise increase in workload (5 W/min for ARM and 10 W/min for CYC) until exhaustion. The highest completed workload was named Wpeak while peak oxygen consumption (VO2peak), ventilation (VEpeak), oxygen pulse (O2Ppeak) and heart rate (HRpeak) were calculated as an average of the last 10s of exercise. Data were compared by two ways ANOVA.

At the same HRpeak, significantly higher Wpeak and VO2peak were attained in CYC vs ARM test (@78% of CYC), before and after training. Following training, while HRpeak remained unchanged, significantly higher Wpeak, VO2peak, VEpeak and O2Ppeak were obtained in both training groups. The amplitude of the increase was significantly higher for homeo-ergometer (~16%) than hetero-ergometer tests (~10%) with no difference due to training.

Our data suggest that CYC (large muscle masses) and ARM (smaller muscle masses) training have a similar potential to increase hetero-ergometer exercise tolerance likely mediated by an increase in O2 transport capacity (central factors). An increase in O2 utilization (peripheral factors) appears to be responsible for the additional increase in exercise tolerance observed in homeo-training.

## P10R-08

**Effect of short-term bouts of maximum intensity on energy metabolism during physical exercise****Golberg Natalia, Rogozkin Victor**

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*Keywords: exercise, muscle, energy metabolism*

The purpose of the present research was to study an influence of short-term bouts of maximum intensity (accelerations) on energy metabolism during predominantly aerobic exercise.

The study was carried out on albino male rats with 230-250g of body mass at the performance of acute physical exercise (E) of two variants. 1 variant - aerobic swimming by duration of 5 or 15 min, 2 variant - swimming of the same duration with inclusion of 1 or 2 bouts of maximum intensity. The animals were investigated at rest, after the termination of E by "free" swimming (before acceleration) or with acceleration, accordingly. Content of glycogen and creatine phosphate (CP) and activity of hexokinase and lipase were determined in skeletal muscle of various metabolic types; lipase activity was also measured in adipose tissue (AT).

It was established, that the swimming of 1 variant results in gradual decrease of CP and glycogen in SM, 2-fold increase of lactate concentration and increase of enzymes activity in oxidative-glycolytic fibers of SM to the end of E. During E of the 2nd variant already after the 1 acceleration energy substrates content in SM reaches 41 % from a rest level and hyperlactacidemia ( $22.1 \pm 1.2$  mM) is observed. The subsequent transition to aerobic swimming results in increase of the glycogen and CP contents and reduction of serum lactate concentration. Inclusion of 1 acceleration activates hexokinase in SM, enriched by fibers II A as on 18 %, with the subsequent increase of activity yet on 13 % at transition to "free" swimming. The lipase activity in SM and AT is authentically reduced after the 1st acceleration that can be connected with its inhibition by lactate action. Subsequent aerobic swimming results in lipase activation in tissues on 30-105 %, in comparison with the level after fulfilment of acceleration. Thus, the degree of lipase activation in slowly twitch SM is so great, that exceeds a level of rest on 50 % and remains authentically higher even after the 2nd acceleration.

Thus, inclusion of short-term bouts of maximum intensity in aerobic E brings to increase utilization not only of CP and glycogen, but also intramuscular triacylglycerols and nonmuscular sources of energy. Their oxidation provides ATP resynthesis not only for muscular contraction, but also for restitution of exhausted energy fuels for working SM.

## P10R-09

**Comparison of liver and gut HSP72 response following hyperthermia****Ruell Patricia A, Hoffman Kylie M, Chow Chin M, Heijboer Annemiek C, Thompson Martin W**

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*Keywords: hyperthermia, HSP72, thermal load*

It is now well known that cells and tissues respond to thermal stress by producing heat shock protein 72 (HSP72), which then protects the cells from a further stress. Most experiments have used a heat shock at 42 °C for 15-20 minutes, a stress unlikely to be encountered by humans except under exceptional circumstances, for example heat stroke or extreme fever. There are few studies describing the

heat shock response at lower temperatures, especially in an in vivo model. Different tissues produce markedly different amounts of HSP72 following heat shock. The purpose of this study was to examine the induction of HSP72 in two different tissues, namely liver and gut, to determine whether the pattern of induction would be the same in these two tissues at different thermal loads.

Sprague-Dawley male rats 7 weeks old were used in this study. Rats were divided into four groups (n=6): a control group, two groups heat-shocked at 41.0 °C for either 15 min (41S) or 1h (41L), and a group heat-shocked at 42.0 °C (42). Four hours following heating the rats were anaesthetised and samples of gut and liver removed and immediately frozen in liquid nitrogen. These samples were then extracted, and HSP72 quantitated by Western Blotting using Stressgen antibody (SPA-810).

In both liver and gut, HSP72 was significantly elevated under the conditions 41L and 42 compared to 41S and control rats. There were differences between gut and liver, however. In gut, 42 caused a significantly greater induction of HSP72 than 41L, while in liver the amount of HSP72 was not significantly different between these two conditions. The thermal load induced by the two conditions 41L and 42 was significantly different ( $43.6 \pm 1.5$  v  $53.9 \pm 3.8$  °C.min<sup>-1</sup>,  $p < 0.05$ ).

Our results confirm that duration of heating is important in inducing HSP72, with a significantly greater induction of HSP72 following 1 hour compared to 15 minutes at 41 °C.

## P10R-10

**Comparison of using creatine kinase and myoglobin to detect muscle damage caused by exercises****Yau Chung-Fai Forrest, Yuan Wai-Yee Yvonne, Tang Yue-Bun Alan, Chan Pui-Yee Cangel, Leung Wing-Man, Renneberg Reinhard**

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*Keywords: muscle damage, concentric contraction, eccentric contraction, muscle proteins*

The aim of this study is to compare the use of creatine kinase (CK) and myoglobin (Myo) to detect muscle damage caused by 4 different modes of exercise on a Cybex machine with knee extensor/flexor. In this project the extent of muscle damage will be manipulated by the type of muscle contraction (concentric vs. eccentric) and the muscle mass involved (single vs. double leg exercise). It is hypothesized that the magnitude of increase in the 2 markers will be correlated to the extent of muscle damage. 8 healthy subjects completed 4 exercises: concentric single Leg (CS), concentric double legs (CD), eccentric single leg (ES) and eccentric double legs (ED). All single leg exercises were performed by the dominant leg. CK peaked at 8h post-exercise (PE) in all 4 exercises. It continued to increase exponentially to 48h PE in eccentric concentric groups (ES:  $p < .01$ , ED:  $p < .05$ ). For concentric contractions, CK began to drop after 8h PE. Myo peaked at 2h PE, which is much earlier than that of CK, in all exercises. It continued to increase exponentially to 24h PE in the eccentric groups (ES:  $p < .02$ , ED:  $p < .05$ ) and returned back to baseline in both concentric groups (CS & CD). In comparing the effect of muscle mass, the trends of CK and Myo responses were similar. The peaks were about 2 times higher in the double legs groups (CD & ED) than the single leg group ( $p < .04$ ). Greater muscle damage after eccentric exercises and larger muscle mass involved during double legs exercises were distinguished by higher plasma concentrations of CK and Myo. Myo was more sensitive to

muscle damage by peaking at about 2h PE, so it can be used as an immediate measurement for damage caused by the previous exercise bout. CK can also serve the same function but the peak will only be detected at 8h PE. It can then be used to detect muscle damage at later time when immediate testing was not allowed.

#### P10R-11

### Effects of eccentric exercise on sarcoplasmic reticulum Ca<sup>2+</sup> uptake and Ca<sup>2+</sup> release in rat skeletal muscle

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**Keywords:** *eccentric exercise, sarcoplasmic reticulum, Ca<sup>2+</sup> uptake, Ca<sup>2+</sup> release*

In this study, we investigated the hypothesis that eccentric exercise would cause modifications of both Ca<sup>2+</sup> uptake and release in rat muscle. Adult male SD rats were randomly assigned to control and eccentric exercise (ECE) groups. The ECE rats were subdivided into one of six groups studied at 0, 4, 24, 48, 72 and 144 h after ECE (n=7). The exercise protocol consisted of a 90min continuous downhill walking (-16°, 15 m/min) on a treadmill. Red vastus (RV) and white vastus (WV) muscles were sampled separately and muscle homogenates were prepared. Ca<sup>2+</sup> uptake and release rates were measured. In RV, Ca<sup>2+</sup> uptake was lower (P<0.05) compared with Control, by 29, 36, and 19% at 0, 4, and 24h post ECE, respectively, and remained depressed at 48h by 14% (P>0.05). Ca<sup>2+</sup> release was also lower (P<0.05), by 37, 39, and 25% at 0, 4, and 24h, respectively, and remained depressed at 48h by 13% (P>0.05). However, in WV, Ca<sup>2+</sup> uptake decreased (P<0.05) by 26% at 4h only, although decrease at 0h by 16% (P>0.05); While Ca<sup>2+</sup> release showed a non-significant decrease (P>0.05) by 17% at 4h, no significant changes were found at other time points. Significant reductions of both Ca<sup>2+</sup> uptake and release rates were observed in RV immediately, 4, and 24h following ECE, and these reductions had not totally recovered until 48h post-exercise. This may be attributed to the low recruitment threshold and relatively important postural roles of these slow motor units. However, similar modifications of Ca<sup>2+</sup> uptake and release in WV were not detected. Ingalls et al. (1998) reported that Ca<sup>2+</sup> uptake and release rates decreased by 21-30% over the first 3-5 d after 150 eccentric contractions, which were elicited via maximal electrical stimulation. The less pronounced decreases found in the present study 48-72h after the exercise may be due to differences in exercise protocol (i.e., voluntary versus electrical stimulation recruit thresholds). It has been proposed that a reduction in the SR Ca<sup>2+</sup> release would account for the low-frequency fatigue induced by eccentric exercise, while a reduction in the SR Ca<sup>2+</sup> uptake would explain for the prolonged muscle relaxation time.

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#### P10R-12

### Exercise and urinary excretion of insulin and c-peptide

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**Keywords:** *C-peptide, insulin, proteinuria*

To measure exercise related changes in the excretion of C-peptide and Insulin and to correlate modifications with the well known post-exercise proteinuria, urine and plasma C-peptide and Insulin were measured before and after a sport competition.

Twenty young well trained cyclists took part in a 2.5 h competition (102 km) and blood and urine specimens were collected before (at rest) and at the end of the physical performance. The concentrations of C-peptide and insulin in plasma and centrifuged urine were assayed using immunoassay methods. Creatinine and total protein concentrations in urine were measured by capillary electrophoresis and spectrophotometry methods respectively. The concentrations of urinary C-peptide measured at the end of exercise, compared with before, decreased slightly, but significantly, ( $21.3 \pm 2.7$  vs  $13.5 \pm 1.7$  nmol/L), but the urinary concentration of Insulin significantly increased at the end of exercise compared with before ( $92.5 \pm 4.2$  vs  $131.4 \pm 15.7$  pmol/L). Urinary concentrations of total proteins and creatinine significantly increased. Both, end of exercise urinary C-peptide/Protein and C-peptide/Creatinine ratios were significantly reduced. The correlation between C-peptide and insulin in plasma was confirmed before the competition as well as at the end of exercise.

The present work verified that: the urinary C-peptide decreased at the end of a strenuous exercise, and the percentage of this variation was 86.4 % in respect to the basal level, the urinary insulin increased at the end of exercise and the percentage was 141.1 % in respect to the basal level. The molar ratio (hormone: creatinine) in urine, was decreased for C-peptide and slightly but not significantly decreased for insulin. In conclusion, the present data suggest that C-peptide and insulin do not appear similarly filtered and reabsorbed by the kidney taking into account the post-exercise proteinuria phenomenon.

#### P10R-13

### Redox sensors in C2C12 and L6C5 skeletal muscle cells

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**Keywords:** *vitamin C, oxidative stress, redox sensors*

Active skeletal muscle cells are continuously exposed to oxidative stress; thus, they must compensate environmental challenges by increasing adaptive responses to free radicals generation.

Here, we compared two muscle cell lines, the mouse is C2C12 and the rat is L6C5 myoblasts, which exhibit different sensitivity to oxidative stress. The higher resistance of C2C12 cells to H<sub>2</sub>O<sub>2</sub>-mediated death may be correlated to their ability to preserve vitamin C. To investigate whether other antioxidant systems were involved, we analysed the role of glutathione, thioredoxin reductase and the redox-sensitive transcription factor NF-κB.

After 15 hr incubation with BSO, both cell lines showed a low GSH content corresponding to 10% of starting glutathione

levels. The same percentage of depletion was reached with different kinetics: L6C5 cells required a higher amount of BSO (100 mM) than that used for C2C12 cells (50 mM). This result reflected a different glutathione metabolism between the two cell lines. Nonetheless, both L6C5 and C2C12 myoblasts are very sensitive to GSH loss, as demonstrated by the increase in ROS production (2-3 folds over control cells). Vitamin C pre-loading had a different effect on the two cell lines: it significantly reduced cellular ROS levels in C2C12 cells (48.8% of reduction with respect to BSO-treated cells), while its effect on L6C5 cells was less pronounced (30% of reduction).

Thioredoxin reductase was more expressed in C2C12 than L6C5 cells. A high baseline of NF- $\kappa$ B activity was observed in the resistant C2C12 cell line; this activity was slightly affected by vitamin C supplementation or H<sub>2</sub>O<sub>2</sub> treatment. In L6C5 cells, the low basal activity was up-modulated by vitamin C and H<sub>2</sub>O<sub>2</sub> alone and this effect was synergistically enhanced by combination of the two compounds.

C2C12 cells, being more efficient in vitamin C recycling, have an additional defence system to utilise in conditions of low GSH. On the other hand, the sensitive L6C5 cell line is more active in maintaining intracellular GSH content. The more resistant phenotype of C2C12 cells may also be achieved by induction of key redox sensors, such as thioredoxin reductase and NF- $\kappa$ B. This hypothesis is corroborated by the finding that susceptibility of L6C5 myoblasts can be abrogated by vitamin C-mediated induction of NF- $\kappa$ B activity.

#### P10R-14

### Interrelation between maximal work power and lipid peroxidation in athletes

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**Keywords:** power, lipid peroxidation

It is known that excessive activation of the lipid peroxidation processes in organism under different extremely conditions (under physical loads in particular) may lead to cell structure disintegrations cell protein modifications and as result - to a decrease of physical work capacity [1]. In that connection the aim of our investigation was study of the relation between maximal work power and intensity of the lipid peroxidation in athletes.

The study was carried out in Ukrainian National University of Physical Culture and Sports (department of human biology). High level athletes took part in the investigation, which had training in cyclic and non-cyclic kinds of sports (rowing, modern pentathlon, basketball, wrestling).

As the experimental physical load was treadmill running with stage raising power at decline.

About intensity of the lipid peroxidation processes judged by concentration one of the lipid peroxidation products - thiobarbituric acid reactioning substances (TBARS) in blood [2].

The results of the study showed changes of TBARS concentration in blood under maximal work power ( $W_{max}$  kg-1) were different between both representatives of different sports and representatives of same sport specialization. Deserve attention the fact reduction of average difference between TBARS blood concentration before and past physical load in athletes with high  $W_{max}$  kg-1 (in pentathlons and rowers  $5.4 \pm 0.2$  W·kg-1 and  $5.2 \pm 0.2$  W·kg-1, correspondently). Among the pentathlons it reduction was equal -  $11.4 \pm 5.3$  nmol·ml-1 and among rowers -  $11.3 \pm 7.8$  nmol·ml-1.

At that time among the athletes with concerning smaller index of  $W_{max}$  · kg-1 (wrestlers,  $4.5 \pm 0.4$  W·kg-1 and basketball players,  $4.4 \pm 0.4$  W·kg-1) was marked the contrast dynamic of TBARS concentration. Among basketball players it index was rising at  $16.0 \pm 7.3$  nmol·ml-1 and among wrestlers at  $67.6 \pm 21.33$  nmol·ml-1.

Thus, the results of study are witness about close interrelation between stages of the antioxidative system in athletes and their ability to manifestation of maximal work power.

For athletes with high  $W_{max}$  · kg-1 is quality more high stability of the antioxidative system that manifestation in absence of TBARS accumulation under testing physical exercise.

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#### P10R-15

### Arm cranking exercise increases platelet aggregation in male spinal cord injured individuals

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**Keywords:** arm crank, platelet aggregation, spinal cord injury

Dysfunctional platelets have been implicated in the pathogenesis and progression of cardiovascular diseases. Over the last two decades, interest has been heightened regarding the effects of exercise and training on platelet aggregation and function, not only in normal healthy subjects, but also in patients particularly those with cardiovascular diseases. Spinal cord injured (SCI) individuals suffer from a host of cardiovascular complications. Although individuals with SCI usually lead a sedentary lifestyle due to low level of muscular strength and cardiorespiratory fitness, they typically use their arms for wheelchair locomotion and various activities of daily living. However the exact effects of vigorous arm exercise in SCI on platelet are not known. Therefore the present study was designed to examine the effects of arm cranking exercise on the in vitro functional activity of platelet as determined by platelet aggregation in SCI individuals and normal healthy subjects.

Five SCI individuals and seven normal subjects performed a submaximal arm cranking exercise bout for 30-min at 60% VO<sub>2</sub> peak. Venous blood samples for determination of platelet aggregation were obtained at rest and immediately after exercise.

Resting mean values of maximal platelet aggregation induced by collagen were not significantly different between SCI individuals ( $45.6 \pm 5.4$ ) and normal subjects ( $46.0 \pm 1.7\%$ ). However, following strenuous arm cranking exercise; maximal platelet aggregation induced by collagen increased significantly in SCI individuals ( $56.6 \pm 7.7\%$ ;  $P < 0.05$ ) but not in normal healthy subjects ( $44.6 \pm 2.3\%$ ;  $P > 0.05$ ) similarly, the resting mean values of platelet aggregation induced by ADP were not different ( $P > 0.05$ ) between SCI individuals ( $41.0 \pm 8.2\%$ ) and normal healthy subjects ( $46.0 \pm 1.7\%$ ). Compared to rest, the SCI group exhibited a greater maximal platelet aggregation induced by ADP following strenuous arm cranking exercise ( $41.0 \pm 8.2\%$  for rest and  $49.2 \pm 8.0\%$  after exercise,  $P < 0.05$ ). In contrast, strenuous arm cranking exercise had no significant effect ( $P > 0.05$ ) in normal subjects. These results suggest that arm cranking exercise in SCI individuals is associated with enhanced platelet activation and possibly greater susceptibility for exercise-related

thrombotic risk. Although the underlying mechanism for exercise-induced increase in platelet aggregation in SCI individuals is not known, this might be caused by greater endogenous release of catecholamines.

#### P10R-16

### Influence of acute exercise on oxidative stress in chronic smokers

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**Keywords:** *smoking, antioxidants, exercise*

In order to examine the collective effects of exercise and smoking on oxidant and antioxidant parameters, young male smokers (n=10) and non-smokers (n=10) made to perform a negative slope (10%) cycling exercise for 30 minutes at individual load equivalent to 60% of maximal oxygen consumption (VO<sub>2</sub>max). Pre- (pre-ex) and post-exercise (post-ex) Haematocrit, Haemoglobin, plasma malondialdehyde (MDA) levels, protein carbonyl formation and non-HDL oxidation, erythrocyte superoxide dismutase (SOD) and glutathione peroxidase (GPX) activities, serum ceruloplasmin (CER) and urinary cotinine concentrations were evaluated.

Pre-ex CER and urinary cotinine concentrations of smokers were significantly ( $p < 0.05$  and  $p < 0.01$ , respectively) higher compared to that of non-smokers and pre-ex CER concentrations were significantly correlated ( $r = 0.579$ ;  $p = 0.01$ ) with cotinine levels. Significant ( $p < 0.05$ ) increases were observed in non-HDL oxidation following the exercise in both groups and the elevations were more pronounced in smokers. Pre-ex SOD and GPX activities were not different between the two groups, however post-ex enzyme activities were significantly ( $p < 0.05$  and  $p < 0.01$ , respectively) reduced in smokers. MDA and protein carbonyl concentrations were not different between the two groups and there were not any significant changes due to exercise.

In conclusion, according to the results of the present study, we suggest that erythrocyte antioxidants SOD and GPX and plasma non-HDL are more prone to the possible oxidant damage of acute physical exercise in chronic smokers.

#### P10R-17

### Nutrition of woman fitness and blood groups

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**Keywords:** *blood groups, vitamins*

The last decades of the 20th century saw a nutrition boom shared by dramatically growing number of people, which brought a lot of scientifically developed diets and eating patterns. Peter D'Adamo and James D'Adamo's concept is among them. The two American researchers have found out a correlation between nutrition and blood type.

The present study aims to analyze nutrition status in shaping exercisers according to their blood type. 1500 females aged between 18 -30 served as subjects for the research.

From questionnaires we have carefully analyzed common nutrition mistakes, and actual vitamin status, which were hypothetically foreseen. The suggested questionnaires were designed by researchers at the St. Petersburg Research Institute of Physical Culture on the basis of clinical biological studies that enable to precisely determine possible and actual nutritional deficiency. Low vitamin C, P, B group content and anemia caused by iron deficiency are commonly found disorders.

The obtained data for vitamins C and P evidences: females with blood type O (18%) have the best index – type B (11%) - possible nutritional deficiency.

Vitamin status analysis (actual nutritional deficiency) shows that females with blood type O (20%) are likely to suffer from lack of these vitamins. Females with blood type B run less risk (14%).

Analyzing B6 status (actual nutritional deficiency) we have found out that blood type AB (6%) are more likely to run the risk for B6 deficiency; while blood type O females (4%) tend to be safer.

As far as vitamins B1 and B2 (actual nutritional deficiency) are concerned we can state that blood type O (20%) and blood type AB females (33%) show worse results.

Iron possible deficiency is highly probable in females with blood type O (6%) and less probable in blood type B subjects (3%).

Iron actual status is higher in blood type B (14% deficiency) and lower in the females with blood type O (22% deficiency).

The conducted research enables us to conclude that there has been found a certain correlation between blood type as well as possible basic vitamins and iron.

## Poster Session

### Health and Fitness 1 - Sports Medicine 1

**P10S**

#### P10S-01

### Acute effects of a single period of exercise on the urinary excretion of 8-hydroxy-deoxyguanosine in humans

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**Keywords:** *8-hydroxy-deoxyguanosine, intensive exercise, oxidative stress*

The urinary excretion of the DNA repair product 8-hydroxy-deoxyguanosine (8-OHdG) has been proposed as a non-invasive biomarker of oxidative DNA damage in humans. It is suggested that physical activity could enhance oxidative

DNA damage if it leads to an excess of oxygen radicals, which might overcome the antioxidant defense systems. This has been studied with urinary 8-OHdG as a marker of exercise-induced oxidative stress. However, the reported results of modifications in 8-OHdG are various considerably different methodologies and protocols. The purpose of this study was to investigate the time course of urinary 8-OHdG and plasma antioxidants after a single bout of exercise in healthy male subjects.

Non-smoking healthy male subjects (n=6; mean age 24.0 ± 1.1 years-old) were studied. Physical characteristics of the individuals were recorded and fitness was assessed by maximum oxygen consumption (VO<sub>2</sub>max) in ergospirometry test. In the present study, urine samples and plasma samples were obtained partially at baseline and 24 hrs follow-up after

60 min of treadmill running at  $72.7 \pm 8.0$  %VO<sub>2</sub>max. The urinary concentration of 8-OHdG was measured by the two-column-switching high-performance liquid chromatography (HPLC) method as described. The levels of 8-OHdG were corrected using the amount of creatinine excreted in urine. Plasma vitamin C was measured using HPLC and plasma vitamin E was detected by a spectrophotometric procedure. Plasma peroxide lipid level was measured by the TBA method.

The mean levels of 8-OHdG started increasing 1 hour after 60 min treadmill running. The significant increases of the urinary 8-OHdG excretions (mean; ng/mg creatinine) were detected at 2, 4 and 6 hrs after exercise, compared to the baseline level (6.03 at 2 hrs, versus  $5.12 \pm 0.47$  at baseline,  $p < 0.005$ ;  $5.90 \pm 0.63$  at 4 hrs, vs. baseline,  $p < 0.05$ ;  $5.64 \pm 0.41$  at 6 hrs vs. baseline,  $p < 0.05$ ). The increased levels of 8-OHdG returned to the baseline within 12 hrs. Plasma peroxide lipid level was unchanged before and after exercise. There were no significant changes in plasma vitamin C and vitamin E from baseline during 6 hrs follow-up after exercise. The results of this study demonstrated that urinary levels of 8-OHdG were significantly increased as a result of physical exercise intervention at  $72.7 \pm 8.0$  %VO<sub>2</sub>max. Our findings indicate that of intensive 60 min exercise induces the transient increase of oxidative stress.

#### P10S-02

### Autonomic cardiovascular control and heart rate variability in case of overweight compared to healthy sedentaries

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**Keywords:** heart rate variability, overweight, autonomic cardiovascular control

As a major part of the metabolic syndrome, Adipositas is among the most common causes for cardiovascular diseases. This condition is associated with a functional reduction in this system. Aside from morphological changes which can be identified through diagnostic imaging techniques, adaptations in the autonomic cardiac control are observed. Heart Rate Variability (HRV) is a new method to monitor the influence of the autonomic nervous system on the cardiac function. The present study aims at describing differences in HRV between overweight and healthy sedentary subjects.

We analysed two age-matched groups (overweight subjects, N=41, 17 men and 24 women, age  $48.26 \pm 7.75$  years, BMI  $31.53 \pm 2.58$  kg/m<sup>2</sup>; ; healthy sedentary subjects, N=20, 10 men and 10 women, age  $45.16 \pm 5.56$  years, BMI  $23.43 \pm 2.41$  kg/m<sup>2</sup>) using automated HRV short term measurement during a standardised 15 minute tilt-test. Average values and group differences were calculated.

During the standardised tilt test, healthy sedentary subjects showed significantly higher autonomic activity (frequency domain: LF%  $79.17 \pm 17.08$  vs.  $62.89 \pm 26.25$ ) in comparison to the overweight collective and a better regulation of autonomic cardiac control.

The sympathovagal balance (frequency domain: ln LF/HF) displayed significant differences between the groups. In the time domain, only the RR interval after tilt testing differed between the groups (sedentary:  $1.03 \pm 0.11$  ms vs. overweight:  $0.95 \pm 0.14$  ms). Furthermore significant differences in time and frequency domain between the two genders in the overweight group, mainly in the resting body

positions of the test were found. In the sedentary group, no gender differences were observed.

In this study, overweight persons showed significant differences in the adaptation capacity of their autonomic cardiac control system compared to individuals of normal weight. The fact that HRV reduction is less pronounced in the female subgroup of the overweight collective could be a hint to the well known fact that women are at lower risk to be affected by cardiovascular diseases. By monitoring changes in these variables, the method of HRV measurement might be a helpful and supplementary tool in the preventive diagnostic of cardiovascular diseases and the documentation of therapeutically interventions.

#### P10S-03

### Neuromuscular evidence of central fatigue during long-duration running exercise

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**Keywords:** EMG, maximal voluntary contraction, central activation

The aim of this study was to examine time course of fatigue during a long duration running exercise performed at 55% of the velocity attained at VO<sub>2</sub> max (V<sub>vo2max</sub>).

To estimate the changes that may occur during this prolonged exercise, neural and contractile properties of the quadriceps muscle were evaluated every hour during short interruptions. Eight well-trained triathletes or endurance runners sustained 55% of their V<sub>vo2max</sub> on a motorised treadmill for duration of 5 hours. Maximal voluntary isometric (MVC) torque, contractile properties and central activation level of the knee extensor muscles (KE) were measured at the end of each hour using an isometric ergometer.

MVC torque and CAL were significantly ( $P < 0.01$ ) reduced after the exercise by -30% and -18%, respectively. Decreases of MVC and CAL became significantly ( $P < 0.05$ ) lower after the 4th hour compared to pre-values of exercise and were highly correlated ( $r = 0.96$ ,  $p < 0.01$ ). In contrast, maximal tetanus torque was not altered throughout the exercise ( $P > 0.3$ ). The findings of the present study showed that a 5-h running exercise performed at 55% of V<sub>vo2max</sub> reduced the maximal voluntary force generating capability in the quadriceps muscle.

The results suggested that peripheral mechanisms such as excitation-contraction coupling process and neuromuscular propagation were not affected during the exercise. In contrast, central fatigue took place during the exercise, especially in the latest stage.

In conclusion, present data proves that central activation failure is the main factor contributing to the loss of neuromuscular performance during long-duration running.

#### P10S-04

### Public-health aspect of the active aging

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**Keywords:** physical activity, elderly, health promotion

According to demographic analyses, a rapid increase of the absolute and relative number of elderly persons is to be expected in the worldwide population. It is estimated that the number of people over 60 will double (605 million to 1.2 billion) in the next 25 years (2000.-2025.) (UN, 1999). These

estimations are surely going to induce not only a demographic transition, but also significant changes in morbidity and mortality, giving rise to an epidemiologic transition. The above mentioned is due to influence politics and healthcare organization, as well as the number of social-economic aspects of a number of countries.

The figures and trends of the worldwide increase of the proportion of elderly persons in the population are present in Croatia, as well.

There is a significant prevalence of ten elected kinesiology sensitive illnesses in the elder population in Croatia. Taking into these diagnoses in younger stratum of population, it becomes obvious that these health disturbances are present in younger adults. Such findings accentuate the need of an active intervention much earlier than in the age of 65 or more.

During the last two decades certain efforts have been made in Croatia to introduce recreation activities in homes and clubs for elderly people. It was not easy to get understanding and support of relevant governmental and social structures. But it seems recently that they have recognized the importance of active aging not only for health benefits and economic reasons in relation to the health, but also as the very important psycho-social measure to promote quality of life of elderly persons.

A constant increase in the proportion of the elderly persons in the population of all the countries in the world, including Croatia, implies a need for planning future political, health-care and social measures.

Physical activity is proved to be among the most important health- and life-quality- related factors, especially for the elderly population.

The analyses of kinesiology sensitive morbidity of elderly people reveals that this morbidity situation is practically the copy of illnesses developed earlier in life. It is logical to accept that systematic physical activity should be applied much earlier in the life course, so the effects would be prolonged and would remain in the third life age.

#### P10S-05

### Ecological influences on the isometric force of the m. quadriceps femoris

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*Keywords: nutrition, maximal force, economy*

Improvements in performance of any sport activity traditionally are achieved by an increase of stimulus' extension and intensity. Apart from this approach a capacity-increase should be evoked by qualitative changes of training methods or by the removal of macroscopical influences. For the measurement of such parameters the systemically oriented medicine offers theories of diagnostics and therapies which are based on a nonlinear understanding of causality. These theories identify individual reactions and deduce individual interventions, which depend on holistic personal conditions. Beside the successful use of acupuncture in cruciate ligament injuries, fluctuations of fundamental physiological parameters caused by geomagnetic changes could be shown. The present investigation examines the influence of selected ecological stimuli on the maximal isometric force of the m. quadriceps femoris.

The stimuli were sugar, oat flakes and placebo tablets held in one hand, as well as a magnetic field produced above the test muscle. The measurements took place before, during,

and after the influence of the stimulations (Cybex 6000, knee angle 90°).

The results point on a reaction of the force level of the non-dominant legs with stimulating substances except the placebo. With sugar stimulation opposite results become obvious between the subgroups, which could be differentiated by the daily sugar consume.

The effect of the directly applied magnetic field can be explained as an electromagnetic interaction between the outside field and the one produced by the muscle. Psychological effects can be basically excluded due to the missing effects with placebo intervention. The small reaction of the dominant legs could be explained by temporarily faster adaptation ability. An explanation for the differently reacting nutrition groups could be the metaphor of an overflowing barrel. However, the detailed mechanism of influencing the neuromuscular system by ecological stimulations has not been explained yet. Changes of sum membrane potentials in anterior horn motor neurons are discussed as a possible reason. These consist of the sum of EPSP and IPSP from different sources. In conclusion, the influence of ecological stimulation to biological systems indicates an increasing capacity by removing influences of the environment. Nevertheless, the ambiguity of explanation-models demands for further research in order to achieve a deeper understanding for the complex ecology of human movement.

#### P10S-06

### Inter-relations between isometric strength in both closed and open kinetic chains and isokinetic strength in elderly women

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*Keywords: muscle strength, isokinetics, kinetic chain*

Across the aging process most elderly experience functional problems, that interfere directly or indirectly with the ability to perform daily activities by themselves. Many of these restrictions are due to alterations in the lower limb such as muscle weakness. There has been some research trying to understand strength decline related to aging, and it's relation with functional ability. Controversial opinions exist regarding the ability of isometric and isokinetic assessments to monitor dynamic performances, as well as the efficacy of isometric evaluations in open and in closed kinetic chains. The purpose of this work was to analyze the interrelations between three different methods to measure strength in the lower limb.

This investigation involved 23 elderly women that were involved in a physical activity program for at least one year. Age, body weight, body mass index and lean body mass were determined. Isometric strength in the closed kinetic chain of the lower limb was assessed using an adjustable dynamometer. Maximal voluntary contraction and rate of force development were measured bilaterally. Maximal isometric strength in the open kinetic chain of the knee was measured at 0 and 90 degrees, using a portable dynamometer (Nicolas Manual Muscle Tester). Isokinetic knee extension was evaluated with a Biodex System III dynamometer at 60 degrees/s and 180 degrees/s. Correlations between variables were assessed by Spearman's test with a significance level set at  $p < 0.05$ .

Isokinetic peak-torque (PKTQ) and total work (TW) averages of both legs at the two velocities were calculated to compare them with data of maximal isometric strength of the lower limb and rate of force development. There was a high correlation between isometric strength in open and closed



kinetic chain ( $r=0.63$ ,  $p<0.01$ ) and a moderate one with the rate of force development ( $r=0.47$ ,  $p<0.05$ ). There was also correlation between isometric strength at 0 degrees and isokinetic peak torque at both velocities (60°/s:  $r=0.47$ ,  $p<0.05$ ; 180°/s:  $r=0.45$ ,  $p<0.05$ ). Rate of force development appears to be correlated with both PKTQ and TW only at a higher velocity (180 degrees/s).

Results indicate that knee extensors significantly contribute to the extension of the lower limb. Variables that express rapid strength (RFDL, PKTQ180° and TW 180°) show to be associated, even in different muscle contractions. For elderly women there is an association between isometric and isokinetic assessments.

#### P10S-07

### **Anthropometry, physical performance capacity and nutritional habits in Swiss children aged 4 - 12 years**

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**Keywords:** Eurofit Tests, nutrition, anthropometry

It was the aim of the present study to investigate the morphological characteristics and the physical performance capacity of Swiss children (aged 4-12 yrs.) in combination with an evaluation of their nutritional habits.

Volunteers were recruited in different schools in the German speaking part of Switzerland. Physical performance capacity was assessed using the Eurofit testbattery. The anthropometric measurements included weight, height, triceps, suprailiac, subscapular and calf skinfold thicknesses and perimeters of the upper arm, calf and bicondylar femur and humerus widths. Nutritional intake was evaluated using a 3-days food questionnaire.

Eighty nine girls and 86 boys participated at the practical experiments. Only 47 food questionnaires could be used for analysis (25 girls and 22 boys). When comparing with the IOS results of 1991 (Beunen et al, 1991) performance was lower for the standing broad jump (10-12 yrs, both sexes), bent arms hanging (7-9 yrs, both sexes) and sit and reach (10-12 yrs girls). Performance was higher for the standing broad jump (7-9 yrs boys).

When comparing with the IOS anthropometric data, measurements indicated a higher body height and a higher body weight, only for the 7-9 yrs old girls. There was no significant difference in BMI in neither of the groups. Triceps, subscapular and supraspinal skinfold thickness was higher for the 10-12 yrs girls. On the somatochart 10-12 yrs girls were found to be central and 10-12 yrs boys mesomorphic-ectomorphic.

Energy intake was sufficient for boys of all age groups but too low for girls of all age groups. Carbohydrate intake was too low while protein intake and intake of saturated fats were too high. The low Ca intake and the high P intake resulted in a very low Ca/P ratio for all age groups.

Most physical performance and anthropometric values were comparable with the IOS data of 1991.

#### P10S-08

### **Evaluation of the sleep patterns and sleep-related complaints, chronotype and adaptation to the time zone in Brazilian athletes participating in the the Paralympic Games in Sydney 2000**

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**Keywords:** chronotype, paralympic athletes, sleep

Many methods have been developed to investigate the quality, the principal complaints and disturb referring to sleep. Well-known ways to investigate the temporal characteristic of the organisms is the chronobiology, a science that divides the population into three basic chronotypes to evaluate the individual differences on predominance by the time of vigil and sleep: matutinals, vespertines and the indifferent. Another important point is that there are few studies referring to the standard of sleep in persons with special necessities and physical activity. The sleep is considered to be a restorer and the exercise is associated with several changes on sleeping standards. The majority of studies corresponding to the effect of the exercise on the sleep can be boarded or correlated with the theory of restoration of sleep's function. The main aim of this study was to evaluate the standard, the complaints related to the sleep, the chronotype and adaptation to Sydney's hour-zone of Brazilians athletes who disputed the Paralympic Games in 2000.

64 paralympic athletes participated of this valuation aged of 26,3 ( $\pm 5,9$ ). All of them answered the questionnaires of standard and complaints referring to the sleep and chronotype, with an adaptation to Sydney's hour-zone also.

The process of synchronization to time-zone was realized in an abrupt way as a trial to break with (light-dark) cycle referring to Brazilians time. The results demonstrated that 34,4% of the athletes presented a dissatisfaction with their own sleep, and the most reported sleep's disturbs were: apnea (14%), gastro oesophageal reflux (15,61%) headache (14,1%) anxiety nightmares (39,1%), cramp (20,3%), sleep talk (26,6%), nocturnal panic (9,4%) Periodic Legs Movement (9,4%) and bruxism (9,4%). In relation to the valuation of the athlete's chronotype, 74,3% manifested indifferent, 6,22% vespertines moderated and 20,31% matutinals moderated.

A good performance with the entire job was observed and the same contributed and reflected on the final results, as the paralympic team had an excellent final result.

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#### P10S-09

### **Handball injuries during major international tournaments**

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**Keywords:** handball, injury, tournament

In handball, like in other sports, injuries often occur during competitions. A standardised assessment is needed to further analyse the frequency and circumstances of injury in players of different age, sex and skill-levels and to compare injuries in different kinds of tournaments and types of sports.

The physicians of all participating teams were asked to report all injuries that received medical attention on a standardized injury report form. The injury report form requested documentation of the following: shirt number of the injured player, time in the match, location, type and circumstances. Questionnaires were collected either after the match or prior to the next match of the respective team by a representative of the International Handball Federation.

Since the Olympic Games 2000, the injuries during six international handball tournaments have been surveyed. A total of 414 injury report forms were filled out and returned. The response rates varied substantially between the tournaments and reached 92% in the Women's European Handball Championship 2002. The incidence of injury ranged between 84 and 155 injuries per 1000 match hours with the lowest incidence in the Women's European Handball Championship 2002. The majority of injuries (on average 83%) arose as a result of contact with another player, and almost half of the contact injuries were caused by foul play as rated by the team physician and the involved player. The body parts injured were predominantly the lower (42%) and the upper extremity (23%), but injuries of the head and neck (20%) were also frequent. In most of the cases the injury was diagnosed as contusion (64%). On average, 35% of the injuries (or one injury per two matches) resulted in absence from a subsequent training session or match. Approximately one injury per tournament had an estimated duration of absence from handball of more than a month.

The incidence of handball injury seems to be high; however the relative risk of injury for a particular type of sport can only be calculated in comparison with others. Injuries in team sports should be investigated using the same definition for injury, mode of data collection, and methods of analysis.

#### P10S-10

### The effects of creatine supplementation and training on muscle mass, strength and endurance in older males

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*Keywords: elderly, training, creatine*

There is much interest in ways the loss in muscle mass and strength which occurs after 30 years of age can be prevented or reversed. Resistance training and dietary creatine (Cr) supplementation have been used for this purpose. This study aimed to ascertain whether Cr supplementation and/or moderate home-based resistance training would increase muscle mass, strength and endurance in elderly males.

11 men (61-72 yrs) volunteered for this 12wk double-blind study forming 2 groups, Cr (n=5) and PI (n=6). All conducted a home-based training regimen of knee extensors and flexors of one leg at least 3x weekly using a weighted cuff. The Cr group took 15g/day CrH<sub>2</sub>O for 2wk and 3g/day for 10wk, PI took an equal amount of dextrose. Training began at 30%max voluntary force (1 set of 12 reps) and resistance was increased by 250g every 1-2wks and sets up to 3/session. Tests included blood creatine, isokinetic and isometric strength and endurance of knee extensors and flexors using a Cybex 6000 isokinetic dynamometer (Ronkonkoma, NY) at baseline and wk 2, 7 and 12. Total body and limb segment mass was quantified by dual energy x-ray absorptiometry (Hologic QDR 4500) at baseline and wk 12.

Improvements in muscle strength were greater for the Cr compared to PI limbs with dynamic strength increasing after

7wk of Cr ingestion (ca 20%, p<0.05), in trained and untrained limbs. Training and placebo supplementation elicited no significant strength improvements. Endurance capacity of the knee extensors was significantly greater following light training with CrH<sub>2</sub>O supplementation compared to the same training in the placebo group at wks 2 and 7. There were no significant changes in total body or segmental lean mass in any of the subgroups.

Supplementation with CrH<sub>2</sub>O can have a positive effect on knee extensor strength and endurance when combined with light resistance training, indicating that such combined interventions may benefit older subjects for maintenance and improvement of muscle mass and strength. Further studies in groups such as elderly females and those with muscular degenerative diseases are warranted.

#### P10S-11

### Immune function and physical fitness in elderly men

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*Keywords: elderly, : physical fitness*

Because of the conflicting results in literature concerning immune function, aging and training the purpose of this study was to determine whether there is an association between the physical fitness level of seniors and their immune function.

28 male seniors (age 69,2 ± 2,6 years) with different physical activity levels were included in this study. Blood samples were collected for analysis of immunological parameters (white blood cell count, differential analysis of leukocytes, lymphocyte subsets, phagocytotic activity of granulocytes and monocytes, natural killer cell activity). To determine the physical fitness level all subjects underwent an incrementally graded bicycle ergometer test until subjective exhaustion.

A significant correlation between age and leukocyte subpopulations was detected. With increasing age the percentage of granulocytes was enhanced (p < 0.05) while the proportion of lymphocytes was diminished (p < 0.05). Furthermore, there was a strict correlation of physical fitness and natural killer cells. Higher values of performance (Watt) as well as maximal oxygen consumption (VO<sub>2</sub>max, VO<sub>2</sub>max/kg), achieved in the exercise ergometer test, were significantly associated with an increased number and percentage of natural killer cells. In addition, a slight correlation between the fitness level and the natural killer cytotoxicity was found (p < 0.1), but failed level of significance.

Endurance training in later life is associated with lesser age-related decline of certain immune functions. Earlier examinations stated that the training condition is of higher influence on the immune system than age. These findings are underlined by the results of the present study. In male seniors the number and the percentage as well as the function of natural killer cells were associated with the performance level reached in the physical fitness test as well as with the maximal oxygen consumption indicating the importance of reaching a high fitness level for the immune function of the elderly. It can be concluded that regular aerobic fitness training is important for the elderly.

## P10S-12

**Training volume influences leptin and stress hormones in highly trained male rowers****Mäestu Jarek, Jürimäe Jaak**

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*Keywords: leptin, stress hormones, training volume*

The purpose of this study was to determine whether fasting plasma leptin, cortisol, testosterone and growth hormone concentrations were altered with a heavy increase in training volume followed by a reduced volume in highly trained male rowers.

Twelve male national standard rowers (age  $20.5 \pm 3.0$  years, height  $187.9 \pm 6.1$  cm, body mass  $87.1 \pm 8.3$  kg, and percent body fat  $10.4 \pm 3.2$  %) underwent a three week period of maximally increased training volume followed by a two week tapering period. The fasting blood samples were obtained every week after the rest day. In addition, maximal 2000 metre rowing ergometer (Concept II, Morrisville, USA) performance time was assessed before, immediately after the exhaustive training period and after the tapering period.

A mean 22% increase in training volume caused a significant decrease (by 8%) and increase (by 9%) in leptin and testosterone concentrations, respectively. A further increase in training volume by 25% significantly reduced leptin further by 35%. At the same time, no changes were observed for testosterone concentration. Growth hormone was significantly elevated only after the first week of heavy training volume compared to the pretraining level. First tapering week, during which the training volume was rapidly reduced by approximately 50%, significantly increased only leptin concentrations by 29%. Testosterone and growth hormone values were significantly reduced to almost pretraining levels by the end of the second tapering week. Leptin was significantly increased further (by 4%) during the second tapering week. Cortisol remained relatively constant during the whole study period. In addition, rowing performance and body composition parameters were not significantly changed during the study period.

It was concluded that leptin is more sensitive to the rapid and pronounced changes in training volume compared to the measured stress hormones in highly trained male rowers. Furthermore, fasting plasma leptin demonstrated a dose-response relationship with training volume and could be regarded as a key signal for metabolic adaptation to exhaustive training stress in male rowers. However, the exact mechanism responsive for the dose response relationship between leptin and training volume without changes in body fat mass in male rowers remains to be defined.

## P10S-13

**Comparison of fat distribution, percent body fat, physical fitness, and physical activity, in relation to cardiovascular risk factors in premenopausal women****Mohebbi Hamid, Rahmani-Nia Farhad, Gaderi Mahbanou**

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*Keywords: fat distribution, percent body fat, cardiovascular risk factors*

A central fat pattern (upper body obesity and abdominal obesity) is related to the development of diabetes, heart disease, and mortality, as well as blood lipid risk factors of cardiovascular disease and increased blood pressure. The purpose of this study was to determine the relationship between fat distributions; percent body fat, physical activity (PA), physical fitness and cardiovascular disease (CVD) risk factors.

Fifty healthy, premenopausal females (aged  $46.6 \pm 5.3$  yr; height  $158.9 \pm 5.5$  cm; weight  $67.7 \pm 9.5$  kg; mean  $\pm$  SD) were take part to this study. Subjects completed an informed consent form, health history, and Baecke physical activity questionnaire. Measurements included percent body fat, anthropometrics, aerobic power ( $VO_{2max}$ ), and CVD risk (blood pressure, total cholesterol, low-density lipoprotein (LDL), high-density lipoprotein (HDL), and triglycerides).

Percent body fat correlated with TC ( $r = -0.33$ ), SBP ( $r = -0.39$ ) and DBP ( $r = -0.28$ ) and WHRs did not correlated with CVD risk. Abdominal circumference was significantly related to TG, HDL, SBP, and DBP while waist and hip circumference was significantly related to blood pressure. In addition, Physical activity was significantly correlated with SBP ( $r = 0.38$ ) and aerobic fitness negatively related to TG ( $r = -0.37$ ), SBP ( $r = -0.33$ ), and DBP ( $r = -0.30$ ).

These results indicate that the overall percent of body fat is more important than the distribution of body fat in relation to these cardiovascular risk factors. However, abdominal circumference was able identify individuals at risk. So the abdominal circumference is directly related to CVD risk while the lower CVD risk found with more aerobic fitness women. It is recommended that both skinfold measurements and the aerobic fitness test should be used as risk assessment tools.

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## Poster Session

## Sports Medicine 2

P10T

P10T-01

**Contusion-induced vascular permeability elevation is inhibited by acute icing application****Lee Hoseong, Natsui Hiroaki, Akimoto Takayuki, Yanagi Kennichi, Ohshima Norio, Kono Ichiro**

University of Tsukuba, Japan

*Keywords: icing, contusion, vascular permeability*

Icing (ice therapy) is generally applied as an initial treatment of acute soft-tissue injuries such as contusions, sprains, and muscle pain. It is widely used not only in clinics but also in the field of sports. However, there is little evidence of the physiological response of injured tissues after icing application. In this study, we intended to examine the effects of icing on contused soft-tissue with particular attention to vascular permeability as an indicator of edema.

Male Wistar rats weighting 100-150 g (4-5 weeks old) were used. Under general anesthesia by an intra-abdominal injection of sodium pentobarbital, catheters were inserted in trachea and external jugular vein. The left cremaster muscle was subjected to an intravital microscopic observation vascular permeability according to the routine procedure. Contusion was induced by a dropped ping-pong ball (diameter: 40 mm, weight: 1 g) from a height of 20 cm to the exposed cremaster muscle. After 5 minutes of the contusion, cremaster muscle was superfused with a saline solution maintained for 10 minutes at a controlled temperature of 37° (control), 27° (cooling), and 3° (icing), respectively. Vascular permeability of the cremaster muscle was visualized using a real-time confocal laser scanning microscope (CLSM) system (CSU-10, Yokogawa, Tokyo, Japan) and fluorescent dyes (FITC-dextran 150s). The recorded images were reproduced to top sending, the FITC leakage area 90 seconds after FITC-dextran administration was measured, the rate of the leakage area occupied within each view was computed, and considered as the index of vascular permeability.

Average FITC-dextran 150s leakage area was significantly decreased in the icing group (3°) following the contusion compared with that in the control group (37°) ( $p < 0.01$ ).

The decrease of leakage area after icing suggests that icing application induces vaso-constriction and development of openings or gaps of vascular endothelial cells. In conclusion, vascular permeability was significantly reduced following icing application. The inhibition of vascular permeability in injured soft-tissue following icing might inhibit both edema and inflammatory reaction.

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P10T-02

**Physiological responses during female competitive sports aerobics exercise****Aleksandraviciene Roma, Stasiulis Arvydas**

Lithuanian Academy of Physical Education, Lithuania

*Keywords: aerobics, aerobic capacity*

The physiological responses of competitive sports aerobics exercise have not yet been widely studied (Rodriguez et al., 1998). Simultaneous measurements of pulmonary gas exchange and heart rate (HR) can now be continuously obtained using telemetric systems (Shulz et al., 1997). These parameters can reflect the physiological demands in this sport, especially if compared to maximal values obtained in the laboratory. The aim of this study was to characterize heart rate, oxygen uptake and pulmonary ventilation during competitive aerobic routine in a group of elite women athletes.

Nine female members of the Lithuanian national team (age  $21.6 \pm 4.4$  year; height  $165.4 \pm 5.0$  cm and weight  $55.1 \pm 6.2$  kg) participated in the study during their competitive period before the World Championship. All subjects performed a maximal incremental treadmill test in the laboratory with continuous measurements of HR (Polar ACCUREX-Plus). The HR deflection point and other parameters of aerobic capacity were determined from the relationship of HR to running speed. Besides, the athletes performed competitive sports aerobics exercise in which pulmonary gas exchange parameters and HR were continuously measured using the telemetric equipment (Cortex 3B). The routines lasted 1 min. 45 s on the average. The changes of HR, minute ventilation and oxygen uptake (VO<sub>2</sub>) were analyzed by adopting monoexponential function.

Sports aerobics athletes have a moderate maximal aerobic power and HR deflection point. The competitive routines are characterized by very intense cardio respiratory demands, attaining average values  $81.3 \pm 5.8\%$  of maximal VO<sub>2</sub>, reaching  $95.2 \pm 4.2\%$  of maximal HR and overstepping the HR break point which is known to be near the lactate accumulation threshold. The HR, minute ventilation and VO<sub>2</sub> demonstrate fast increase at the start of competitive exercise with almost leveling-off later. The highest rate of increase was observed for HR, the lowest one - for minute ventilation. A strong correlation was established between maximal VO<sub>2</sub> determined in the laboratory and VO<sub>2</sub> measured during the competitive routine ( $r=0.872$ ;  $P<0.05$ ).

Competitive sports aerobics exercise can be considered as a sport with high cardio respiratory and metabolic demands, in which anaerobic sources are intensely activated.

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## P10T-03

**Mechanical power, myoelectrical activity and potassium increase during interval hand-grip exercise of high intensity**

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Medical School Hanover, Germany

*Keywords: EMG, fatigue, potassium*

There are evidences that the accumulation of the extracellular K<sup>+</sup> may decrease the amplitude and propagation speed of the muscle action potential. Stimulation of the Na<sup>+</sup>-K<sup>+</sup>-pump can counteract the induced by shifts of the ionic balance depolarisation of the sarcolemma. We have examined the behaviour of the EMG and m-wave during high intensity fatiguing exercise in relation to ionic composition in plasma and power output.

The experiments were performed on 9 volunteers during 10 dynamic handgrip exercise bouts of 15 sec. 45 sec rest followed each exercise bout. The subjects were instructed to maintain maximal contraction frequency. Surface EMG and m-wave were recorded from the flexor muscles of the forearm. Blood was drawn from the cubital vein draining the working forearm muscles. Acid base state, [K<sup>+</sup>] and [Na<sup>+</sup>] in plasma were determined. RMS, median frequency (MF) and contraction velocity (CV) were computed. The obtained ionic concentrations were used for the simulation of the muscle action potential. The possible effects of the Na<sup>+</sup>-K<sup>+</sup>-pump and the gradient between venous and interstitial [K<sup>+</sup>] were taken into account.

From the beginning of exercise RMS declined continuously and stabilised after the fifth bout at 79.5±13.1% (p<0.05). MF decreased in the course of every exercise bout by about 30% (p<0.005) and recovered almost completely during the break. The loss of maximal CV in the course of the first five exercise bouts was about 38%. During every exercise bout CV decreased and recovered partly during the resting period. Both, MF and RMS correlated with the CV. Plasma K<sup>+</sup> increased after each exercise bout with a maximum of 6.27±0.97 mM/l after the second one. The m-wave area decreased after the bouts, but after the second one it began to rise during the breaks continuously. The MF of the m-wave did not undergo any significant alteration during the bouts. The power output in our experiment was directly proportional to CV. The simulation showed a very close agreement with the changes of the m-wave.

Our results demonstrate: 1) the power output during intermittent dynamical exercise of high intensity strictly depends on electrical activity of muscle; 2) the decrease of some parameters of EMG and the rise of the extracellular K<sup>+</sup> develop in parallel during exercise of high intensity and 3) the changes of the m-wave are of another magnitude and have other time characteristics than plasma [K<sup>+</sup>] and mechanical power.

## P10T-04

**Effects of a multidisciplinary weight-reduction programme on activity patterns, physical capacities, energy expenditure and body composition in severely-obese adolescents**

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*Keywords: body composition, physical activity, energy expenditure*

The objective of the present study was to determine the variations in body composition, physical capacities, and the longitudinal variations in time and energy expenditure (EE) devoted to various activities by severely obese adolescents, during a nine-month weight-reduction period.

Twenty-six (12 boys and 14 girls) adolescents (mean BMI: 33.9 kg/m<sup>2</sup>; 41.5 % fat mass, FM), aged 12 to 16 years, were admitted to a specialized institution to follow a multidisciplinary weight-reduction programme including lifestyle education, moderate energy restriction, progressive endurance and strength training and psychological follow up. Before the beginning and at the end of the weight-reduction program, body composition was assessed by dual-energy X-ray absorptiometry (DXA), physical capacities by multistage treadmill test, and EE both by whole-body calorimetry and in free-living conditions using the heart rate-recording method. During eight-months of the weight-reduction period, type and duration of each activity were recorded every day using an activity diary, and EE was estimated from the duration, intensity and interpolated energy costs of the various activities.

BW and FM decreased (- 19 % and - 42 %, respectively, P < 0.001) both in boys and in girls, and FFM decreased only in girls (- 6 %, P < 0.001). O<sub>2</sub>max (l/min) did not vary significantly, but strength and fitness were improved (P < 0.001). Time and EE (Figure) spent at sedentary activities (1) decreased significantly (P < 0.001) to the benefit of moderate (recreational) activities (2) and total physical activities (3) (P < 0.001), at the institution, during the weekdays and at home during the weekends and holidays. In addition, time and EE spent at sleep decreased at home during the weekends and holidays (P < 0.001). Increasing leisure physical activity and maintaining moderate energy intake is essential to preserve the benefit of the cure, because BMR and the energy costs of sleeping, sedentary and physical activities, and daily EE assessed by whole body calorimetry, decreased (P < 0.001) during the weight-reduction period.

The great BW and FM losses, preservation of FFM, improvement of physical capacities, as well as lifestyle education prompted the obese adolescents to increase leisure physical activities in free-living conditions at the expense of sleep and sedentary activities. Maintaining this lifestyle is essential to preserve long-term body weight control.

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## P10T-05

**Rolimeter reliability compared with the KT1000 in ACL deficient and normal knees****Papandreou Maria, Antonogiannakis Emmanuel, Xiotis Ioannis**

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*Keywords: ACL, rolimeter, KT1000*

Several investigations have reported the accuracy, reproducibility and reliability of the KT1000 arthrometer as a knee assessment following ACL injury or reconstruction. The Rolimeter is a new simple device and it can provide measures of anterior/posterior tibial translation using only manual maximal force. Few studies have examined the reliability of Rolimeter compared with the KT1000. The reliability of Rolimeter has been mainly reported for injured knees. The purpose of this study was to evaluate the reliability of Rolimeter compared with the KT1000 in patients having ACL deficient and normal knees.

Fifteen males (24.33±3.71 age) with unilateral ACL deficiency and normal knees were evaluated with KT1000 and Rolimeter by the same tester in one occasion. Patients were classified to sub acute phase of ACL injury. The KT1000 and Rolimeter exams were performed with the patient in supine position with the knees in approximately 25 degree flexion. The amount of anterior tibial translation for both knees recorded applying manual maximal force that derived the reliability of results.

Correlation coefficients revealed high reliability between Rolimeter and KT1000 for deficient knees ( $r=0.751$   $p=0.01$ ,  $\alpha=0.84$   $p=0.05$ ) and for normal knees ( $r=0.814$   $p=0.01$ ,  $\alpha=0.896$   $p=0.05$ ). Side to side differences in Rolimeter measurements compared with KT1000 showed significance at low correlation ( $r=0.572$ ) at the 0.05 level and correlation coefficients revealed reliability between them ( $\alpha=0.7255$   $p=0.05$ ).

These results suggest that the Rolimeter measurements are correlated with the KT1000 measurements. Rolimeter provides a reliable measure for ACL deficient and normal knees in higher load displacement tests. Side to side differences between Rolimeter and KT1000 did show reliability and therefore should not be used to determine as the important indicator of pathology due to low correlation between their differences.

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## P10T-06

**Non-linear parameter of heart rate variability compared to creatine kinase, serum urea, haemoglobin and haematocrit in athletes during a two year training period****Lehnen Jens, Niessen Margot, Hartmann Ulrich**

Technical University Munich, Germany

*Keywords: heart rate, training, blood*

Heart rate variability (HRV) is a relevant marker to reflect the sympathovagal balance and provides information about short- and long-term adaptation during regular physical exercise. The object of this study was to investigate the intraindividual correlation of the longitudinal behaviour between the HRV parameters and the blood characteristics (creatine kinase (CK), serum urea (SU), haemoglobin (Hgb) and haematocrit (Hct)) during a two year training period.

Within a longitudinal study we observed 9 male (m) (25,9±3,4y; 183,6±10,9cm; 77,0±12,0kg) and 5 female (f) (23,0±2,6y; 169,0±6,5cm; 68,0±19,6kg) athletes (elite distance running (DR), judo (JU), rowing (RO), cycling (CY)). Blood pictures were performed in apotabsorptive state in the early morning (6:00-9:00h) with Cobas-Bio®. The beat to beat heart rate measurement (POLAR® Vantage NV) was carried out directly after awakening in the supine position in bed before arising. The raw signal was filtered with regard to physiological limits. The time series (ms.) was transformed into a symbol sequence using the alphabet  $A=\{0,1,2,3\}$  applying the parameter  $a=0.05$  and the mean  $m$ . The Renyi entropy (RENYI) was calculated applying the order  $q=0.25$  and the word length  $k=3$ . The relative frequency (PL10) of the word ( $k=6$ ) '000000' was determined using the simple alphabet  $B=\{0,1\}$  and the transformation using the limit  $g=10$ . The significant correlations (two-sided at level  $p<0.01$  (\*\*)) and  $p<0.05$  (\*) between the HRV parameters and the blood characteristics provide for RENYI and HB: DR5f: .299\*, RO4m: -.392\*. CY1m: -.671\* and CY2m: .621\*. For RENYI and HC: RO4m: -.408, CY2m: .482\*. The results for PL10 and CK: DR3: .436\*\*, RO1f: .523\*\*, for PL10 and SU: DR3m: .296\*, RO1f: -.361\*, RO4m: .370\*, CY2m: .454\*; for PL10 and HB: DR1m: .218\*\*, JU1m: -.495\*, JU2f: .480\*.

The statistical analysis reveals an inconsistent chart. Athletes are different with regard to their individual pattern of HRV and to their different training response time process. Better insights might be gained applying these factors to separate groups using a discriminant analysis. Furthermore it must be mentioned that non training specific factors affect both the HRV (e. g. psychological factors, emotions) and the blood values (e. g. CK by muscular micro traumas, SU and HC by fluid balance). Further studies should focus the attention to minimize resp. to monitor these influencing variables in further investigations.

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## P10T-07

**The correlation of muscle strength and EMG power spectrum during isokinetic knee exercise in hip extension position****Kuo Fang-Chuan, Lin Jung-Chang**

Hung Kung University, Taiwan

*Keywords: muscle strength, isokinetic exercise, EMG power spectrum*

Most functional activities of the knee joint were performed in hip extended position. However, in the context of isokinetic knee measurement, the fatigability of quadriceps muscle in hip extended positions has been poorly studied. The purpose of this study was to evaluate and clarify the correlation of muscle force and spectrum myoelectrical activity during isokinetic exercise in development of muscle fatigue in supine with hip flexion 10° positions.

Fifteen male subjects (mean age 24.0±2.1 yr) who have no history of knee injury went through forty repeated maximal concentric knee extension and flexion exercises at 90°/s angular velocities in supine with hip flexion 10° position. The Quadriceps forces were measured with Cybex II dynamotor. The surface myoelectrical signals were registered from middle of the rectus femoris muscle using the ME3000P Fast Fourier Transform spectrum analysis program (Amplifier type=differential type, Gain=500, GMRR > 130dB, frequency band=20-470HZ, filter =5-470 HZ). The Quadriceps force (QF), mean power frequency (MPF), and zero crossing rate

(ZCR) were selected as fatigue parameters. The change rate per minute was determined for each parameter and the correlation was examined by stepwise linear regression.

All these parameters decreased apparently linearly from the beginning of the test in different decrease rate (QF=57.86±15.27%, MPF=14.08±6.58%, ZCR=13.66±6.81%). There is no significant linear correlations between QF and MPF, but significant linear correlations were found between QF and ZCR, and the equation was  $QF=79.229+1.563 L690$  ( $R^2=0.485$ ,  $P<0.01$ ).

There are no significant high linear correlations between quadriceps muscle forces and the MPF, ZCR of rectus femoris muscle. There are two reasons contributing the result. THE first reason is the different mechanism between isokinetic dynamotor and the surface EMG of rectus femoris muscle in fatigability detection. And the second is the rectus femoris muscle contributes only about 17% of the total isokinetic maximal knee extension moment. We neglected the remaining vast majority also contributes to the total extensor moment generating capacity. This indicates that MPF, ZCR may be used carefully for estimating force production during fatiguing dynamic contractions when a direct measure is not available.

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#### P10T-08

### Changes in capillaries with regeneration of skeletal muscle

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**Keywords:** capillary, muscle, regeneration

The skeletal muscle is composed of huge cells called muscle fibers. Therefore, the surface area of a muscle fiber is small for its volume, and it does not allow substances to pass easily through the cell membrane. Substance transfer thus requires the intense activity of capillaries, because capillaries supply nutrients and chemical substances and carry away wastes. In particular, more intense activity of capillaries is required during regeneration. However, there is only scant literature that deals with the relationship between capillary activity and muscle regeneration. The goal of this report is to clarify the changes in capillaries during regeneration of skeletal muscles.

8-month-old female ICR mice were used in this study. The gastrocnemius muscle was injured by the injection needle injury method and the muscles were fixed at regular intervals. Serial paraffin sections were made and they were stained with hematoxylin-eosin and alkaline phosphatase.

One hour and eight hours after injury, the existence of alkaline phosphatase positive capillaries were confirmed around the damaged muscle fibers. One day and two days after injury, the number of capillaries drastically decreased. Three days after injury, the existence of many capillaries was confirmed again and that ran in the direction of the muscle fibers. Four days after injury, myotubes appeared and capillaries were confirmed around them. Five days after injury, the capillaries existed continuously.

In the injection model, we reported that the fragmentation of nuclear DNA of muscle fibers was induced and segmental necrosis was observed. The experiment made this time showed segmental necrosis again one hour after injury. One hour and eight hours after injury, the existence of capillaries was confirmed around the muscle fibers that showed

segmental necrosis. After that, the number of capillaries temporarily decreased, but many were confirmed again three days after injury. There is a greater possibility that the capillaries shown three days after injury are newly grown. Moreover, the nutrients and chemical substances that are essential to growth and differentiation for the injured muscle fiber will probably be supplied by the newly formed capillaries, because they were observed around the myotubes.

#### P10T-09

### Immunosuppression appears to be independent from muscle exertion during soccer training

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**Keywords:** immunosuppression, muscle exertion, soccer training

Research evidence indicates that intense and prolonged periods of training, induces muscular overstress and immunosuppression, resulting in performance deterioration. Although the source of overtraining and suppression of the immune system is severe training, which is prevalent during the preparatory period in team sports, research failed to obtain a constant relationship between them. The aim of this study was to examine the relationship of these phenomena during soccer training since there is no evidence concerning this field.

Nineteen soccer players, participated in a 6 week high frequency training program during the preparatory period, followed by a 10 week similar volume training during the competitive period. At this period, however, training frequency was decreased by 46%. Blood samples were obtained at the beginning of the preparatory period, as well as at the beginning and at the end of the competitive period. Overtraining markers and immunological parameters were measured. A Pearson correlation coefficient was applied in order to examine the relationships between the measured parameters and their changes, observed during training.

According to the findings of this study, better relationship demonstrated among the immunological parameters, as compared to the overtraining markers. The examined muscle overstress indices and the immune status parameters don't seem to relate to each other, since only a few correlations were observed between them.

This study demonstrates that there is no consistent relationship between overtraining and immunological parameters and their changes during high frequency exercise in soccer. It seems that muscle disturbance caused by exercise was inadequate to establish an apparent inflammatory response in our soccer players. Probably this can be explained by the muscle adaptations as a result of training. On the other hand, our data is in agreement with the literature evidence, which indicates that overtraining markers do not specify muscle exertion at the same level. Although the moderate correlations observed, the immunological parameters exhibit, a more constant relationship among them and their respond to exercise as compared to the overtraining indices. In conclusion this study illustrates that muscle exertion seems to be independent from immunosuppression during soccer training.

## P10T-10

**Comparison of some antropometric and morphological characteristics between ice hockey players and a control group in Kocaeli**

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*Keywords: anthropometric data, ice hockey*

Our subjects were 21 male ice hockey players from municipality of Izmit, as well as 21 males who make up the non-active control group which is not involved in regular or organised sports activities. The average age of the sportsmen included in the study was  $18,56 \pm 1,71$  and average age of the control group was  $18,46 \pm 1,91$ .

These people have all been dealing with ice hockey for at least 5 years. Care was taken to ensure that the people were elite and professional sportsmen who had daily training 10 hours a week. We evaluated the goniometric measurements and grip strenght only in the upper extremity in ice hockey. In this study age, height, weight anthropometric measurements (extremity lenghts, assessment of normal joint movements, body mass index, cormique index, upper and lower part index, acromio-iliacus index, hip index and somatotip), compared with the control group.

As a result of goniometric measurements there were significant differences in hyperextension, hyperadduction, external and internal rotation degrees of shoulder, pronation, supination, radial and ulnar deviation degrees of wrist between ice hockey players and control subjects. These values were greater in the ice hockey players. This condition correlated with increased joint flexibility.

Compared with controls, ice hockey players had decreased elbow flexion degree. We suggested that the hypertrophy of the biceps brachii muscle could be the reason of the decrease. Biceps brachii muscle, waist, calf, knee, hip, shoulder, forearm, biacromial and biiliac circumferences of ice hockey players were significantly higher than the control subjects because of hypertrophy of the muscles. The grip strenght in the ice hockey players was higher than the non-active groups. In the ice hockey players, body fat values were significantly lower than the control group. We concluded that the ice hockey players participated regular sport activity.

## P10T-11

**Non-invasive assessment of the cardiac hypertrophy in trained swimmers compared to pathology**

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*Keywords: vectorcardiography, LVH, hypertrophy*

The particularities of the ventricular depolarization and repolarization in physiological hypertrophy produced by exercise have been less studied than those of the pathological hypertrophy.

In the present work we have made an echocardiographic, electrocardiographic and vectorcardiographic analysis on a group of 20 trained swimmers (A), only males, and on a group of 50 patients (B) with pathological left ventricular hypertrophy (LVH) caused by arterial hypertension, ischemic

heart disease, valvulopaties. They were investigated by echography to emphasize the morphological LVH. The electrocardiogram (ECG) and the vectorcardiogram (VCG) were performed on each subject. The VCG analysis consisted in a computerized calculation applied both on the instantaneous parameters of the maximal vector of the QRS and T loops and on the global parameters of the QRS loop.

In 80% of the subjects in group the A we have found morphological LVH, echographically proved by a slight increase in left ventricular mass (LVM) and also in the cardiac index (LVM/Sc). All the subjects in the group B have had increased LVM; 60% had systolic LVH (B1) and 30% had diastolic LVH (B2).

We found that the indirect criteria for LVH on ECG - as increased S wave and high positioned ST segment in V2 - are predominant in the group A. We also found an increased spatial perimeter of the QRS loop (PQRS) as the most sensitive criterion for LVH on VCG in both groups A and B correlated to an increased LVM only in the group B.

Despite of the lack of correlation between the morphological and electrical particularities for physiological LVH in our group A compared to the group B we could emphasize that the ECG particularities and PQRS on VCG are important electrical indicators of the adaptation of the heart to the exercise during the swimming training.

## P10T-12

**Immune function and physical activity in children**

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*Keywords: physical activity, immunity, immonoblobulin A*

There has been some evidence that exercise influences natural immunity, T- and B-cell functions, as well as cytokine responses through hemodynamic changes and hormonal secretion in response to physical stress in adults. Intense training in elite athletes has been linked to a weakened immune system, and increased risk of infection at the mucosal levels in adults. On the other hand, moderate exercise has shown to enhance cell-mediated immunity (CMI) and increase Immunglobulin A (IgA) concentration leading to improved immunity against infection. Recently, it has been found that moderate physical activity reduces the incidence of upper respiratory tract infections (URTI) by as much as 30% in physically active adults, when compared to inactive adults while increasing resting concentration of salivary Immunglobulin A (slgA). The purpose of this study was to examine the relationships among physical activity, body composition, stress related and immunity variables in grade-five children (10-11yrs) of Southern Ontario.

The 29 boys and 31 girls, who participated in the study, performed a 20m-shuttle run for prediction of aerobic fitness. Bioelectric impedance was used to assess relative body fat (%BF). Standardized questionnaires were used to determine physical activity related variables and frequency of upper respiratory tract infections (URTI). Resting saliva samples were collected and tested for salivary cortisol, salivary Immunoglobulin A (slgA), and slgA/albumin ratio. Students wore a pedometer for 48h to estimate their average total distance traveled per day.

Salivary IgA was significantly correlated with reported URTIs but not related to salivary cortisol, physical activity, fitness level or relative body fat in this age group. Children who spent more time in sport activities and had higher aerobic fitness reported fewer sickness days. Children with relative body fat higher than 25% reported significantly ( $p < 0.05$ ) more



sickness days than the rest of the cohort. There were no gender differences in sIgA, URTI frequency and cortisol levels.

It was found that resting secretory immunity is not strongly related to fitness and physical activity in this age group, but there is evidence that reduced physical activity and the excess of relative body fat can result in higher URTI incidence.

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#### P10T-13

### Stochastic power output during cycling improves subsequent run time to exhaustion in triathletes

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University of Toulon-Var, France

**Keywords:** performance, triathlon, strategy

While laboratory-based research generally involves a constant power output (PO), cyclists typically vary their PO during racing conditions (Palmer et al., 1994). Variations in PO may affect subsequent exercise performance as cyclists can complete a 20-km time trial significantly faster following 150 min of constant cycling compared to a stochastic effort of equal duration and mean power (Palmer et al., 1997). The aim of this study was to investigate the effect of constant versus stochastic cycling exercise on subsequent high-intensity running performance.

Eight triathletes completed two incremental step tests to exhaustion to determine maximal oxygen uptake and the lactate threshold for both cycling and running. The following testing sessions, conducted in a random order, required the subject to perform 30 min of cycling at either a constant PO (CON) (90% of LT), or a stochastic PO (STO) with PO alternating every 5 min (+ 20% of CON PO). Each cycling bout was immediately followed by a high-intensity treadmill run to exhaustion (RTE).

During cycling, no significant differences were found for mean metabolic values or PO between CON and STO conditions. However, the lower PO in the final 5 minutes of cycling during STO compared to CON ( $213 \pm 23$  W v  $265 \pm 30$  W;  $p < 0.05$ ), resulted in a significantly lower metabolic load during the final 5 min of STO. A significant improvement in RTE was reported after 30 min of STO ( $15.0 \pm 4.6$  min) compared to CON ( $10.4 \pm 3.4$  min).

The results of this study demonstrate that, despite similar average physiological responses during 30-min of cycling, STO results in an improved running performance compared to CON. The increase could be explained by a reduction in metabolic load observed during the final minutes of STO cycling exercise. This is the first study to show that different cycle pacing strategies, which result in a similar average physiological stress, can improve subsequent running performance.

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#### P10T-14

### Optimised primary prevention of inactive postmenopausal women by means of physical activity and dietary modification: the postmenopausal exercise prevention program (PEPP)

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**Keywords:** cardiovascular risk, postmenopause, metabolism disorders

According to the WHO-Report 2002, cardiovascular diseases are the most common cause of death in postmenopausal women in the western world (1). The hormonal and metabolic changes during and after the menopause have a negative effect on various cardiovascular risk factors (2). This study was designed to evaluate the effects of an individualised, combined exercise and dietary intervention on the lipid- as well as on the overall cardiovascular risk profile of physically inactive postmenopausal women with dyslipidaemia.

35 postmenopausal women ( $59.8 \pm 6.6$  years, weight:  $69.8 \pm 8$ , BMI:  $25.9 \pm 3.8$ ) with dyslipidaemia (total cholesterol (Tcl):  $289 \pm 54$ , LDL:  $185 \pm 48$ , HDL:  $72 \pm 14$  mg/dl, body fat mass:  $32.3 \pm 5.2\%$ , blood pressure (BP):  $130.2 \pm 19.4/90.7 \pm 8.5$  mmHg) were examined. A four week dietary intervention was followed by an endurance-training based exercise programme, three units walking and one unit of moderate gymnastics over 12 weeks ( $4 \times 90$  min/week).

Dietary modification alone had no significant influence on lipid metabolism, body weight, body fat mass or BP.

The combination of dietary modifications and exercise therapy led to a significant ( $p < 0.001$ ) reduction of the plasma concentrations of Tcl ( $255 \pm 40$ ) and LDL ( $159 \pm 33$  mg/dl (Fig.1)), as well as the systolic and diastolic blood pressure ( $124.1 \pm 17.4/86.4 \pm 10.6$  mmHg) ( $p < 0.05$ ). The body weight ( $65.8 \pm 9$  kg) and the body fat mass percentage ( $30.7 \pm 5.2\%$ ) were also significantly reduced.

The positive effects of a combined exercise-therapeutical and dietary therapy on the lipide profile, the cardiovascular risk profile and on the physical performance result in an improvement of the cardiovascular total risk profile of postmenopausal women and reduces cardiovascular morbidity and mortality. Summarised it can be stated, that an intervention concerning lifestyle, consisting of dietary modifications and exercise therapy constitutes an effective non-medication therapeutical option for postmenopausal women with increased cardiovascular risk.

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#### P10T-15

### Effects of sauna on patients with pain of rheumatoid arthritis

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**Keywords:** rheumatoid arthritis, pain, sauna

45 male (from 44 to 54) patients with rheumatoid arthritis referred to the Medical Center of Mashhad City were selected. According to the research purpose, 3 groups were performed each containing 15 subjects and studied for 28 days. The severity of pain was measured by V.A.S. in days 1,

15 and 28, for all groups and days 16 and 29 for the experimental groups with use of cool water after sauna. Before and after sauna the range of motion was measured with a goniometer and the intensity of pain was determined in all groups. During the research process, the control group (A) didn't use sauna, experimental group 1 (B) used sauna weekly and experimental group 2 (C) used sauna twice a week.

Results indicate statistically significant effects of sauna in reducing pain in rheumatoid arthritis patients in both experimental groups, although no statistically significant results between the two experimental groups were found. The day just after sauna, the experimental groups using cool water mentioned no increase of pain.

According to these results and a repetition of this research, it seems that sauna may reduce pain of rheumatoid arthritis in association with other non invasive treatment.

## Poster Session

### Health and Fitness 2

P10U

#### P10U-01

##### Rapid cardiovagal reactivation after cessation of exercise in children and adults

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**Keywords:** heart rate, cardiovagal reactivation, oculo-cardiac reflex

In the present study, we tested the hypothesis that the age-related delay in cardiovagal reactivation is associated with age and regular exercise, and that is related to responded rapidly cessation of central command in children and adults. We used two approaches to measure the relationship between the time constant of recovery heart rate (HRTC) and regular exercise in age, and to measure the decay rate for 5 sec (HRDR) immediately after cessation of exercise using ocular pressure.

Subjects were healthy children (n=22) and healthy adults (n=98), who either were sedentary and habitual moderate exercise. To measure the many subjects in this study, the test was performed by pedaling exercise (60 rpm) for 5 minutes using 11~12 workload of Borg's scale. All subjects were in the sitting position while resting on the bicycle ergometer after the exercise. Further, the oculo-cardiac reflex was elicited by air pressure device at 80 mmHg on the subject's closed eyelids. The eye pressure was performed at rest and just before the cessation of exercise. The HRTC and HRDR of the heart rate were calculated from the decay of the beat by beat heart rate in each experiment.

HRTC was progressively slower with increasing age. The HRTC in regular exercise group was faster in the young subjects than in either the middle-age or the old subjects (37±5 vs. 46±11 or 56±15 sec,  $p<0.05$ ). In sedentary group, the HRTC was slower in the old subjects than in either the middle-age or the young subjects (108±37 vs. 85±28 or 57±11 sec). In contrast, HRDR did not differ among groups and also regular exercise or sedentary groups. However, in children HRTC and HRDR did differ as compared with adults. Both HRTC and HRDR were faster in the children than in adults (30±5 vs. 52±22 sec, 2.1±0.6 vs. 1.3±0.6 HR/sec,  $p<0.05$ ). Further, HRDR was increased rapidly by ocular pressure just before the cessation of exercise. This oculo-cardiac reflex was significantly related to great HRDR.

HRTC was progressively slower with increasing age and also in sedentary than in regular exercise subjects. The effects on central command in recovery heart rate showed changes of HRDR by oculo-cardiac reflex. This suggested that the HRTC relates to the HR control mechanisms so that the sympathetic withdrawal is mediated by some of arterial baroreflex, and that the HRDR relates also to accelerating the switch of the cardiovagal reactivation by sensitivity of arterial baroreflex.

#### P10U-02

##### The effects of a systematic physical exercise program on blood viscosity in older men

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**Keywords:** elderly, physical exercise, blood viscosity

Whole blood viscosity is positively correlated with coronary heart disease. Increased viscosity has been noted in association with hypercholesterolaemia, diabetes mellitus, hypertension, elevated haematocrit, smoking, obesity and decline of cognitive function. Habitual physical activity has received much attention in this respect as a potential protective factor for these alterations. The purpose of this study was to verify the effects of exercise training on blood viscosity during endurance exercise at an anaerobic threshold intensity in older men.

Forty six healthy subjects aged 60-75 years ( $66.97 \pm 4.80$  years), were recruited and divided into 2 groups: those who trained at an anaerobic threshold for 60 min/ day, 3 times weekly for six months on cycle ergometer (n=23), and sedentary subjects control group (n= 23). All the volunteers were submitted to a basic evaluation before the programming of physical exercise (tests of maximum effort with electrocardiogram, ergospirometric test, body composition, blood samples). Blood viscosity was measured at 37°C with a Wells-Brookfield Cone-Plate Viscometer, before and after exercise programming; hydration was controlled. Evaluation was repeated after six months.

The results revealed that the experimental group blood viscosity decreased significantly,  $Vo_{2max}$  increased ( $p<0.05$ ), changes in the body composition were not significant.

The data suggest that the reduction in this rheological parameter may be an important mechanism through which physical exercise protects cardiac events and that long term exercise training at an anaerobic threshold can reduce blood viscosity in older man. This may represent an interesting therapeutic option for the chronic expansion of plasma volume, thus, increasing blood flow.

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## P10U-03

**Randomized controlled trial of exercise programs for physically independent elderly on physical fitness and health**

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**Keywords:** *fitness, elderly, health*

Physical functions of older people are wide spread, from physically dependent, physically frail, physically independent, physically fit and physically elite (Spirduso, 1995). Physically independent is relative low health and fitness reserves, so that they are critical to live independently. This study designed exercise programs for physically independent elderly to improve their physical fitness and health status and to evaluate effects by a randomized controlled trial. The purpose of this study was to examine the effects of 6 months exercise programs for physically independent elderly on physical fitness and health.

Eligible participants were 466 women and men, aged over 70 years who live in Tokyo and completed medical examinations. Subjects were excluded if they were over 80 years of age, higher functional capacity. Thirty-eight subjects were stratified for age, sex, physical performance tests and functional capacity and were randomly assigned either an exercise group or a control group. The exercise group (n=19) did a 90 minute exercise session, twice a week for six months. The exercise session included aerobics, muscular resistance exercise, and stretching. The control group (n=19) did a 90 minute stretching once a month. The subjects completed physical fitness tests and self-administrated questionnaires at 0, 3, and 6 months after starting the programs. Physical fitness tests consisted of grip, knee, and ankle strength, sit and reach, functional reach, 5-m normal and maximum walking, and 400-m walking. The questionnaires were history of disease, self-rated health and functional capacity.

At the beginning and 3 months after starting the program, no difference was found between the exercise group and control group in any physical performance test, or any item of questionnaire. 6 months later, the 400-m walking time was significantly shorter in the exercise group (from 343 to 307 sec) than in the control group (from 322 to 312 sec). Self-rated health increased in the exercise group (from 2.78 to 3.00 points) but not in the control group (from 2.94 to 2.88 points). No other measure found any difference between the exercise group and control group.

Six months programs for physically independent elderly were effective in 400m walking time and self-rated health. Therefore, it is suggested that exercise programs for physically independent elderly result in improved aerobic capacity and subjective health.

## P10U-04

**Body esteem and percent body fat among British school children**

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**Keywords:** *physical activity, body fat, body image*

Body image may be an important variable in children's quality of life, psychological well being, physical activity participation and body fatness. The aim of the present study

was to examine the relationship between body esteem and body fatness in British children.

Two hundred and sixty seven British secondary school children (121 boys and 146 girls) aged between 11 and 14 years of age (Mean age  $\pm$  S.D = 12.5  $\pm$  0.8 years) took part in the study. Following informed consent from all participants and their parents the Body Esteem Scale for Children was completed individually. Percent body fat was measured using skinfold measure employing the child specific Slaughter et al (1988) equation. The relationship between body esteem and percent body fat was determined by means of Pearson product moment correlations. Univariate ANOVA was used to examine any differences in body esteem and percent body fat according to age, gender and ethnic group.

Results indicated a significant inverse relationship between percent fat and body esteem for the whole sample ( $r = -.535$ ,  $p < 0.01$ ). Similar inverse relationships between body esteem and percent body fat were also evident for boys, girls, white children, Black children and Asian children ( $r = -.473$ ,  $p < 0.01$ ). In all cases higher percentage body fatness was associated with lower body esteem. Significant differences in percent body fat were evident according to gender with boys being leaner than girls ( $F_{1, 260} = 7.413$ ,  $p < 0.01$ ). No significant differences were evident in body esteem scores according to gender, age or ethnic group (all  $p > 0.05$ ). Results of this study support previous work conducted by Duncan et al (2002) indicating a significant relationship between body fatness and body image.

Interventions aimed at enhancing children's body image should also focus on children's levels of body fatness when examining this issue.

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## P10U-05

**The level of physical fitness of regular practitioners of physical activity over 10 years**

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**Keywords:** *physical fitness, mid-age*

The purpose of the present longitudinal study was to compare the level of physical fitness of regular practitioners of physical activity over 10 years.

The subjects comprise 20 men, mean average of 47,8 $\pm$ 6,0 yrs. They attended two sessions of 75 minutes each every week. The program included aerobics, muscular endurance, stretching, and games to improve balance, coordination and agility. The subjects performed the tests every year. The t-Test and the level of significance  $p < 0,05$  was used to compare the mean averages to paired samples.

The results were: 1) Body weight:  $x_1 = 74,7 \pm 12,3$ ;  $x_2 = 77,4 \pm 13,0^*$ ; 2) 12 minutes race:  $x_1 = 2270 \pm 303,4$ ;  $x_2 = 1937,1 \pm 297,9^{**}$ ; 3) Sit-up:  $x_1 = 37,2 \pm 7,4$ ;  $x_2 = 36,4 \pm 10,1$ ns; 4) Push-up:  $x_1 = 22,3 \pm 6,3$ ;  $x_2 = 22,6 \pm 4,4$ ns; 5) Sit-and-reach:  $x_1 = 27,2 \pm 8,4$ ;  $x_2 = 24,6 \pm 8,0^{**}$ ; 6) Standing long jump:  $x_1 = 211,2 \pm 20,8$ ;  $x_2 = 209,5 \pm 15,3$ ns; 7) Shuttle run:  $x_1 = 12,04 \pm 0,75$ ;  $x_2 = 11,75 \pm 0,68$ ns; 8) 50m race:  $x_1 = 8,48 \pm 0,49$ ;  $x_2 = 9,29 \pm 0,37^{**}$ ; 9) Plate tapping:  $x_1 = 10,27 \pm 0,99$ ;  $x_2 = 9,86 \pm 0,83$ ns. (\* $p < 0,05$  / \*\* $p < 0,01$  / ns non-significant difference).

The analysis showed that the body weight increased about 0,27 kg a year, confirming the literature data (about 0,3 kg a year). With regard to balance, coordination and agility non-significant decreases were observed for most of them, suggesting that the content of the program was enough to stabilise those components, although they were practised only twice a week. Concerning the decrease of the aerobic component, the program did not show effectiveness, since the literature predicts a loss of about 10% per decade and it can be related to the emphasis upon walking against running as a healthy way to stay fit. Another point of concern was the little increase of the mean average of arms strength and improvement of agility, which showed a marginal difference of significance, contrasting with the loss of speed and it could be explained by the inclusion of game activities. According to the results we have some indications that a systematic and regular basis of a physical activity program may be responsible for maintaining and/or improving practitioners' physical fitness. Anyway, more longitudinal studies with the same age group would be necessary to conclude its benefits. Another fact of concern is that the subjects were already mid-aged at the beginning of the study (over 36 yrs.) and some of them were over 60 yrs. at the end.

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#### P10U-06

### Changes in physical activity habits during pregnancy

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**Keywords:** *physical activity, energy expenditure, pregnancy*

Despite advances in exercise physiology during pregnancy there is no consensus about the effect of different physical activity levels on maternal-child health. Few studies investigated the diary physical activity habits changes during pregnancy. The objective of this study was to identify the physical activity habits of pregnant of a public health service.

A sample of a prospective cohort study of 130 pregnant women ( $24.2 \pm 4.9$  years-old) attending a low risk antenatal clinic directed to the underprivileged socio-economical population was undertaken. The data was obtained from interviews with the women held in the antenatal service in three different periods:  $16.1 \pm 2.9$ ,  $22.3 \pm 2.2$  and  $35.7 \pm 1.3$  weeks. The physical activity measured included all daily activities (housework, job activity, recreation, physical exercise and locomotion). To quantify its intensity a classification proposed by National Research Council (NCR, 1989) was used: basal, very low, low, moderate and vigorous intensity. Energy expenditure was calculated using the basal metabolic rate (BMR) proposed by WHO (1985) and multiplied by group of activities by NCR (1989). The changes in physical activity habits in the study were assessed through an one-way Anova with repeated measures, followed by a Bonferroni test.

From the NCR classification the women studied did not do any vigorous activity. Posture, walking and moderate activity did not change during the gestational period. The time spent with very low intensity activities was smaller in the 2nd ( $3.45 \pm 0.23$  hour/day) and 3rd ( $3.01 \pm 0.22$ ) trimesters compared to the 1st trimester ( $4.14 \pm 0.27$ ). They spent fewer

time doing low intensity activities during the 3rd ( $2.88 \pm 0.34$ ) than in the 2nd trimester ( $3.82 \pm 0.37$ ). Energy expenditure increased during the three trimesters ( $2011.3 \pm 26.7$ ,  $2090.3 \pm 26.8$  and  $2277.1 \pm 26.4$  kcal/day, respectively).

The main change in physical activity habits of pregnant occurred in the very low and low intensity activities. It was found a decrease in the time spent in both intensities. However, even with the decrease in the time spent in very low and low intensity activities, the energy expenditure increased during the three trimesters. This increase in energy expenditure can be related to the higher basal metabolic rate (BMR) in this period.

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#### P10U-07

### Body composition of elite swimmers

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**Keywords:** *body composition, gender, master*

The aim of the present investigation was to analyze the body composition of master's participants of the III South American Championship of Master Swimming in short swimming-pool.

A sample of 87 masters swimmers, were recruited at III South American Championship of Master Swimming that took place in Rio de Janeiro, Brazil, 2002. Fifty-seven men ( $42 \pm 12,8$  years;  $13,1 \pm 9,1$  years of training;  $10,5 \pm 9,5$  hours/week of training) and 24 women ( $47,8 \pm 14,8$  years;  $9,3 \pm 7,9$  years of training;  $7,4 \pm 3,3$  hours/week of training) filled out a questionnaire with general questions about their habits. The body composition was esteemed by an anthropometric method. Body perimeters, bone diameters, skinfold-thickness, total body mass and height was measured. The sample was divided into 10 groups according to sex and age. All male groups presented a high skinfold thickness in the abdomen and a smaller in the biceps. Mesomorphy followed by endomorphy were the two predominant components of the somatotype for men. All female groups presented a high high skinfold thickness in the thigh and a smaller in the biceps. Endomorphy followed by mesomorphy were the two predominant components of the somatotype for female. The male groups presented better classifications about percent body fat (%BF) in relation to the female groups and the higher time and load of training must explain it. 62,3 of the male sample presented %BF classified as in the healthy standard. This result was expected by the fact that they practice aerobic activities. However, 13,2% presented %BF classified as above the average, 15,1% were classified as bad and 9,4% were classified as very bad. Only 20,8% of the female sample presented %BF classified as in the healthy standard, that means a bad prognosis. 20,1% presented %BF classified as above the average, 41,7% were classified as bad and 16,7% were classified as very bad. This must be explained, among others, by the load and time of training not being efficient and/or sufficient to change the body composition of these athletes. All male and female groups presented waist-to-hip ratio in the healthy standard.

The male groups above 40 years old presented %BF in the healthy standard and the male groups below 39 years old and all female groups presented %BF above the healthy standard. It is recommended to intensify the aerobic training to stimulate the fat metabolism of these groups and promote %BF changes. Acknowledgement: FUJB, FAPERJ.

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## P10U-08

**Age and gender differences in physical activity measured by accelerometry in childhood and adolescence**

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*Keywords: physical activity, childhood, adolescents*

The purpose of this study was to evaluate age and gender differences in physical activity (PA) in children and youngsters.

Sample comprises 103 individuals (49 female, 54 male) grouped as follows: group 1 [aged 6 to 11 years, n = 32 (16 boys and 16 girls)]; group 2 [aged 12 to 12 years, n = 48 (23 boys and 25 girls)]; and group 3 [aged 16 to 18 years, n = 23 (15 boys and 8 girls)]. PA was evaluated with CSA 7164 accelerometer for 7 consecutive days. Bouts of PA and minutes spent in moderate-to-vigorous PA (MVPA), vigorous PA (VPA), and very vigorous PA (VVPA) were examined. The differences between boys and girls and between age groups was analysed with Kruskal-Wallis Test.

Daily MVPA and VPA exhibited a significant inverse relationship with age groups. There are very few minutes spent in VVPA in all groups. Boys of all age groups were more active than girls. Participation in continuous 20-minutes bouts was very low, mainly in older groups.

Children and youngsters have no sufficient daily PA; during childhood and adolescence PA declines markedly.

## P10U-09

**Ways of using forbidden substances in body-building athletes**

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*Keywords: body building, substances*

The aim of this paper was the verification of the biostatistic parameters for users of anabolic steroids and other similar substances, its categorization, the verification of the substances used and the way they have been used as well as the influence of these substances to the athletes within 4 years.

A named, optionally, questionnaire was used that the athletes completed during their personal interview with the researcher. The personal interviews and the optional physical and clinical exams have been done with the author's expenses. The elaboration of the facts has been done according to biostatistics methods, which the researcher has been taught in the Aristotles's University of Thessaloniki during his medical training and with the use of contemporary statistic programs.

The results of this research have three directions. 1. The separation of the athletes' population according to sex, age, place of accommodation, cultural level, occupation, marital situation. 2. The exact definition of the substances that the athletes have used, their quantity and quality as well as the time they have been used. 3. The immediate results of these substances to the users' organism and the long-term influence in four years time.

All the results are expressed in statistic tables and statistic facts for better understanding of the public.

The use of anabolic steroids and similar substances is an existing problem of the Greek society as the marketing, distribution and use is done in places of amateur sport and entertainment as gymnasiums of the Greek state and from

people who are not necessarily occupied with professional sport, but have the willing to obtain a slender body. The above research in which the paper is written, has been done for the first time.

*Knekt et al. American Journal of Clinical Nutrition. Gey et al. American Journal of Clinical Nutrition.*

## P10U-10

**Physical Activity patterns among elderly active women according to CSA & IPAQ**

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*Keywords: physical activity, elderly, sensor monitor*

The focus of this paper was to analyze the physical activity (PA) profile of elderly active women using a movement sensor (CSA), and the International PA Questionnaire-IPAQ.

The sample comprised 37 elderly active women, 52 to 73 years-old ( $\bar{x} = 65.0 \pm 5.5$  yrs), involved in a regular PA program (low impact aerobics), twice a week, 50 minutes/session, in a senior center in the last 5.4 years. Sample mean body weight was  $73.0 \pm 10.8$  kg, and body height was  $156.5 \pm 6.8$  cm. The PA pattern was determined through two methods: a) sensor of movement: a CSA (7164 model) was used attached at the right hip level, during 7 consecutive days, at least 12 hours per day. Time spent (min/day) in light, moderate, and vigorous PA was measured based upon published cut-off limits; besides the total energy expenditure, the number of 10-minute and 30-minute episodes of PA per day were calculated; b) Questionnaire: using IPAQ (version 8, short, self-administered, last week form) energy expenditure (kcal/week) was predicted for each type of PA, according to Ainsworth, B et al. (1999).

Data showed that most parts of the day (94.1%) were spent with light PA, and no time was spent in vigorous PA. However, considering the minutes of moderate PA per day ( $\bar{x}$ : 42min.) or energy expenditure, it was verified that these women met the CDC/ACSM PA recommendations ( $>1500$  kcal/week) in both methods (CSA and IPAQ). Energy expenditure was slightly (non significant) higher when measured through CSA than IPAQ. Moreover, it was observed that they accumulated about 6-7 bouts of 10min/day, and 1-2 bouts of 30min/day; reaching the CDC/ACSM recommendations in terms of minutes/week (at least 150min).

Present findings suggest that elderly active women reached the CDC/ACSM recommendations by accumulating 10-min episodes of moderate PA, without any involvement in any kind of vigorous PA during the week.

## P10U-11

**The influence of light physical activity on postprandial lipemia in healthy but not endurance trained young people**

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*Keywords: physical activity, triacylglycerol, postprandial lipemia*

Delayed postprandial lipemia is an independent risk factor for coronary heart disease. Regular endurance exercise improves blood lipids in the fasted as well as postprandial state. However, information on the influence of single bouts of light physical activity corresponding to the minimal

recommended duration of daily 30 min is scarce. We, therefore, investigated if 30 min of light cycling reduced postprandial lipemia in normal weighted and healthy but not endurance trained people.

15 subjects (8 men and 7 women) aged 24 (5) (mean (SD)) years with a BMI of 21 (2) kg/m<sup>2</sup> participated in this crossover study, each one performing an activity (A) trial (30 min cycling) and a control (IA) trial (no physical activity). The subjects were non smokers, their physical activity was less than three hours per week and did not show any known metabolic disorders. After an overnight fast and measurement of fasting capillary triacylglycerol (TAG), the subjects either cycled for 30 min on an ergometer (perceived exertion of 9 according to Borg RPE scale) in the A trial or rested in the IA trial. Then they received breakfast (fat 0.5 g/kg body mass (BM), carbohydrates 1.7 g/kg BM and protein 0.3 g/kg BM) and 3 h later lunch (fat 0.4 g/kg BM, carbohydrates 1.6 g/kg BM and protein 0.4 g/kg BM). TAG was measured hourly for 6 h after the first meal to assess postprandial lipemia. Respiratory exchange ratio (RER) was measured in the fasted state and 3 and 6 h after the first meal. To compare TAG and RER between trials repeated measures, ANOVA was used.

Subjects had normal fasting TAG levels (1.4 (0.5) mmol/L). Heart rate during exercise was 108 (14) 1/min. Postprandial lipemia was not statistically different after 30 min of low intensity cycling (men:  $P=0.716$ ; women:  $P=0.951$ ). The incremental area under the curve (dAUC) for postprandial TAG in the A trial was 24 % and 42 % lower compared to the IA trial for men ( $P=0.324$ ) and for women ( $P=0.138$ ), respectively. RER was not significantly affected by activity ( $P=0.476$ ).

A single bout of 30 min low intensity cycling reduced dAUC after two meals, corresponding to current recommendations for macronutrient composition, in healthy but not endurance trained younger people. However, the reduction was not significant, likely due to either the short duration and/or low intensity of the activity, and/or the moderate fat content of the meals.

#### P10U-12

### Exercise and colon cancer: Alterations of haematological parameters and immunological activity markers in colon cancer patients after five weeks of moderate exercise training in the aftercare

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**Keywords:** *immune system, colon cancer, physical exercise*

Physical exercise may prevent cancer risk. Mainly in the case of colon and colorectal cancer the beneficial effects are most representative. Physical exercise may cause an increase in gut motility with the consequence of a decrease of carcinogen transit times. Physical activity also influences immunological parameters. Only little knowledge exists for the health benefits of physical exercise in the aftercare. Therefore, the purpose of this study was to investigate the influence of a 5 week ergometer training on physical performance and on parameters of the immune system in the rehabilitation of colon cancer patients.

49 colon cancer patients took part in the study; 25 patients belonged to the training group, 24 to the control group. Ergometer exercise training was performed once a day for about 40 minutes, 5 days per week for 5 weeks at a moderate training level. Before and after the 5 week training

period venous blood samples were taken to determine haematological parameters (HKT, MCV, MCH, MCHC, THR, MTV, TKT, TVB). In addition, the expression of activity markers on lymphocytes and monocytes (HLA-DR, IL-2) were analysed.

At the end of the study there was a significant increase in physical performance, measured by the training duration and the physical power of the patients. In addition, the haematokrit increased because of the training. The HLA-DR+ lymphocytes decreased for the whole group in the aftercare. No significant alterations in the activity marker expression could be found due to the training. In the male training group the receptor density of HLA-DR-positive lymphocytes tends to an increase.

In conclusion, our study preliminary shows positive effects of physical exercise on the physical performance during the rehabilitation and aftercare of colon cancer patients. Nevertheless, the training duration seems to be short for detectable adaptations of the immune system. For the future, longitudinal studies in this field have to be designed in order to draw solid conclusions about the tertiary preventive effects.

#### P10U-13

### Women's past and present physical activity

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**Keywords:** *physical activity*

The objective was to determine the interconnectedness of physical activity during adolescence with the physical activity during adulthood.

Participating in this research were 100 women of an average age of 42 years. The questionnaire contained 30 questions of which 17 related to physical activity during adolescence, 8 to physical activity in adulthood, and 5 were on general matters. The women in the group, who were and are now physically active, usually indicated that their reasons for exercising was a desire to be healthy and energetic (34.2%), and to gain all around improvement (20%). Of these women, 35.2% claimed that their parents had urged them to attend sports groups and employ movement as much as possible during adolescence. 65.3% said that their physical education teacher had been in terrific athletic form, and a true authority; 65.0% said that the teacher ran their physical education classes actively and interestingly. Of the women in the group, who were physically active during adolescence but are now inactive, 27.5% claimed that their parents urged them to exercise in adolescence. That their physical education teacher was in terrific athletic form, and a true authority was stated by 62.0%; that the teacher ran the physical education classes actively and interestingly was reported 50.1%. Of the women in the group, who were physically inactive during adolescence but are now active, 28.5% said that they had started to exercise, because they want to be strong and not give in to daily difficulties; 21.4% claim that they want to be healthy and energetic; 20.5% want to lose excess weight. During adolescence, 80.0% reported that their parents had not helped them gain an understanding about exercise. Only 30.0% said that their physical education teacher had looked athletic; 25.3% said that their physical education classes had been interesting and active. Of the women in the group, who were and are physically inactive, 85.5% answered that their parents had not helped them form positive determinations about physical activity. Furthermore, 42.3% said that the physical education teacher did not appear to be an athletic

person; 25.2% were not satisfied with the way physical education classes had been run.

#### P10U-14

### Investigating posture at 9-years old active boys

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*Keywords: children, football, posture*

Functional disorders of posture among young school children are more rear than structural. The basis of these disorders can be found in the disbalanced, shortened and weaker muscles. The presence of fine neurological semiotics reveals the connection of the hypotonic trunk and extremities with the immature central nervous system. The aim of this study was to notify postural disorders at 9-yr old active and inactive boys and to reveal their influence on the onset of lower back pain later in life.

The experimental group was formed out of 30 9-yr old active boys (football players) and 30 inactive boys of the same age formed the control group. The following parameters were observed: position of shoulders, thorax, triangles of stature, position of pelvis, knees, foot, head, cervical lordosis, thoracic kyphosis, lumbar lordosis, abdominal wall, recurvatum of the knees, position of scapulae, cervical, thoracic and lumbar spine, length of extremities, strength of abdominal muscles, length of back extensors and lower leg flexors. The existence of flat foot is physiological in this period and is considered as a phase in skeletal development. Bended shoulders are present at 43.3% of inactive and 26.7% of active boys; protrusion of the abdominal wall is present at 33.3% and 10%, respectively. This can be explained as general hypotonus and immature CNS. At a smaller number of boys we found shortened back extensors (16.7% in active and 13.3% in inactive). Similar case is present with lower leg extensors. At active boys structural changes of lumbar and thoracic spine were less present than at inactive boys. Asymmetric scapulae are more frequent at inactive boys (around half of them) compared with active boys (one quarter of them).

In this period of life growth is accelerated with a disproportion of costal and muscular structures that might lead to morpho-functional changes on the spine. Pain among sportsmen appears at 30-70%, and in school children at 58.9%. Postural disorders are more frequent at inactive children and the appearance of pain in sportsmen is not related to postural disbalance but probably to sports or other risk factors.

#### P10U-15

### Leisure time variables associated with childhood obesity

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*Keywords: leisure-time activity, obesity, overweight*

There has been an increasing rate of obesity among children in the developing countries. According to the Center for Disease and Control from USA (2000) overweight children aged from 5 to 10 years already have at least one risk factor for heart disease, including elevated blood cholesterol, blood pressure or increased insulin levels, factors that lead to hypertension, diabetes and arteriosclerosis. Sedentary lifestyle and junk-food diets are the reason for such a severe

obesity epidemic. Children spend more time playing electronic games than any other activity besides sleeping. Watching television causes obesity by one or more mechanisms: (i) displacement of physical activity, (ii) increased calorie consumption while watching or, caused by the effects of advertising, an (iii) reduced resting metabolism. In that way, the purpose of the study was to verify the association between free time activities developed in different contexts and overweight and obesity in school age children from 6 to 10 years.

The sample included 451 males and 409 females aged from 6 to 10 years from Felgueiras in the north of Portugal. The free time places and activities were available by a questionnaire applied to the children and filled by their parents and their teachers. Overweighed and obesity was calculated by body mass index assessment using the cut of points proposed by Cole et al. (2000)\*. Association was assessed using the Phi, Cramer, and contingency table correlation tests.

Negative and significant associations were found between the playground, street, garden and childhood overweight and childhood obesity. Positive and significant associations were found between: (i) home and childhood overweight and obesity; (ii) TV time, electronic time and childhood overweight and obesity.

The results indicate that the places where children spend free time are important and determine the type of the activities that could be more active or more passive. We also can conclude that large and open places like playgrounds, street and gardens, promote active lifestyles that are not associated with obesity. Instead, free time spent in places like the house, promote passive behaviours like watching television and play video games, activities that are associated with obesity.

*Cole T et al. (2000). Establishing a standard definition for child overweight and obesity worldwide: international survey. BMJ, 320: 1-6.*

#### P10U-16

### Strength training vs. aerobic training: cardiovascular tolerance in elderly adults

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*Keywords: heart rate, blood pressure, aging*

The aim of the present study was to evaluate the cardiovascular tolerance of two different types of exercise (strength training vs. aerobic training) in healthy elderly subjects.

Nineteen healthy elderly subjects aged 65-81 were studied. All the subjects participated in a 6-month combined physical activity program of gymnastics (2 times/week; 50 min.) and strength training (2 times/week; 40-50 min.). Gymnastics sessions consisted in generalised physical activity that is usually offered to elderly people and included: warm-up, aerobic exercises, strength training, some balance and coordination exercises, recreational games and cool-down. The strength training consisted of two sets of 10 to 12 repetitions at 70% of one repetition maximum (1RM) for "women's double chest"; "leg extension"; "overhead press"; "seated leg curl"; "lateral raise"; "leg press" and "abdominal machine".

Cardiovascular tolerance was evaluated both by measuring heart rate (HR) continuously (Polar Vantage NV) during the sessions and by measuring systolic (SBP) and diastolic blood pressure (DBP) with an electronic sphygmomanometer in five different periods ("baseline"; after warm-up, 15-20 min., 30-40 min. and after cool-down). Moreover, in order to get the

response according to the type of exercise, in strength training sessions, SBP and DBP were also evaluated in different machines (legs vs. arms).

Comparison between the two different types of exercise (gymnastics vs. strength training) and between different machines was performed by an unpaired Student's t-test. The level of significance was set at  $p < 0.05$ .

The results showed no significant differences on HR, SBP and DBP values between the two training types. Both sessions were performed with an adequate intensity without

exaggerated cardiovascular response. In strength training, those exercises that involve legs presented higher rises on SBP and DBP values than the ones performed with arms.

This data suggests that, if appropriate techniques are considered, strength training can be performed by healthy older subjects as well as gymnastics without evident risk from a cardiovascular standpoint. Furthermore, the data evidences a higher cardiovascular hemodynamic response after strength exercises with legs than with arms.

## Poster Session

### Psychology 1 - Motor Learning 1 - Computer Science 1

P10V

P10V-01

#### GPS-technologies and endurance diagnostics in cross country skiing: comparison of commercial and high-resolution GPS-technologies

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*Keywords: cross-country skiing, GPS, endurance sports*

The recording of speed and altitude data serves as a basis for scientific analyses in training and movement science. Traditional methods offer only average data, lap times or data with low spatial and temporal resolution. The application of high quality GPS technologies allows promising possibilities in order to combine speed and altitude gauging with data of endurance diagnostics. In order to record actual position and speed continually, we used two different GPS systems. A high-quality Leica GPS system and a Garmin pocket system. In addition to that, the actual altitude was recorded by a Polar heart rate monitor. On a cross-country trail five athletes were equipped with the three measurement systems. Due to the fact that there was no forest on the test trail, the conditions of the GPS study were at an optimum. Many cross-country skiing trails lead through forests where difficult satellite reception prevails. For this reason, additional test measuring was taken in wooded areas.

The comparison between the Leica and the Garmin system shows clearly the differences. While the real length of the ski run measures 3.59 km, the Garmin system measured 3.83 km. There are also clear differences in the altitude data. While the Garmin system has distinct problems with the recording of altitude, the Polar watch shows reasonable results. For diagnostics, speed development is even more important than altitude profile. Here, the two GPS-systems show good correspondence. In contrast to that, the results in forest are quite different. From time to time, the Garmin-system shows no satellite reception. Therefore, there are no data for some parts of the track and some points clearly differ from the real track. Speed data that is gained by this method shows huge differences compared to the real speed profile.

The results show that the data of commercial GPS systems are less precise than high-quality GPS-systems. Therefore, it is necessary to define the aim of measurements. The Leica system is expensive and not easy to handle. Due to weight and size, it also restricts the runner. Therefore the system's suitability during regular training is questionable, but the system can be used for specific scientific problems or in order to gain reference values. Under good conditions, the combination of commercial GPS systems and heart rate monitors with altimeter provide satisfactory results. In

wooded areas, commercial GPS systems are useless. Here, high-quality GPS systems should be applied.

P10V-02

#### Alterations in mood state following an ultra-marathon

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*Keywords: depression, mood state, ultra-marathon*

Chronic moderate intensity exercise is associated with positive mood changes. However, few studies have investigated the changes in mood state following acute bouts of strenuous, prolonged exercise. In addition, anecdotal reports suggest that endurance athletes may experience feelings of depression following an intense aerobic session. The purpose of this study was to monitor alterations in post exercise mood state following a strenuous bout of running using the Profile of Mood States (POMS) questionnaire, and to determine the time period required for these alterations (if any) to be resolved.

Males ( $n=9$ ) and females ( $n=5$ ) preparing for an ultra-marathon completed the POMS inventory 7 days before the race (baseline), 24 h pre, immediately post-exercise (IPE), 3 h post, and then daily for 13 days after the race. A one-way ANOVA was computed to determine any significant changes in mood states. Significance was set at  $p < 0.05$ .

No significant change in depression, confusion and anger were found. Tension was significantly decreased at 3 h post exercise ( $p = 0.048$ ) and remained significantly decreased up to day 4 after the race, as well from days 9-13. Vigor was significantly elevated ( $p < 0.05$ ) 24 h before the race and significantly ( $p < 0.05$ ) reduced IPE. Fatigue was significantly reduced ( $p < 0.05$ ) 24 h before the race and was significantly elevated IPE ( $p = 0.0007$ ) and 3 h post ( $p = 0.01$ ). Total mood disturbance showed an increase IPE and general decrease over the following twelve days until reaching a significantly lower level ( $p = 0.01$ ) at day 13. The athletes exhibited no significant changes in the level of depression up to 13 days post exercise. However, tension was significantly decreased from 3 h after the race up to day 4 and again from days 9-13. A baseline value from which the ANOVA was run was taken at 7 days pre-exercise. When analysing the results, it becomes apparent that fatigue and vigor were significantly ( $p < 0.05$ ) different when comparing 7 days pre-exercise with 24 h pre. It raises the question when baseline values should be obtained, as many studies using the POMS use reference values obtained immediately before a race/event.

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P10V-03

**The effects of motivational imagery on physical performance and RPE in a controlled sport setting**

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*Keywords: motivational imagery, physical performance, RPE*

The present study examined the effects of two types of Motivational imagery (Motivational General-Mastery and Motivational Specific imagery) on physical performance and perceived exertion, in a controlled sport setting.

Specifically, 15 males completed a nine-minute treadmill run (toward a distance and speed goal of achieving 1800 metres by running at 12km/hr-1), under three treatment conditions; a Motivational General-Mastery (MG-M) imagery condition, a Motivational Specific (MS) imagery condition and a control condition. Prior to each experimental condition, the participants were asked to rate their intrinsic and extrinsic motivation for the task, and also their confidence to achieve the goals that were set. At the end of each experimental condition the following measurements were recorded for each participant; the running speed, the running distance, heart rate and ratings of perceived exertion (RPE). In addition, in each condition, the participants completed a post-experimental questionnaire asking them to rate how each condition affected their confidence, intrinsic motivation, and extrinsic motivation.

One-way ANOVA's with repeated measures on condition revealed that there were no significant differences in the participants' intrinsic motivation, extrinsic motivation and confidence prior to each condition. Four one-way ANOVA's with repeated measures on the condition factor were used to analyse the performance (speed, distance, heart rate) and RPE data. The results indicated that the MS imagery condition produced a significantly higher speed than the control condition. There was also a trend toward significance in the mean distance and heart rate data, with the two imagery conditions producing the furthest distances, and highest heart rates. However, there was no significant difference between conditions in RPE levels. The results from the post-experimental questionnaire, analysed using one-way ANOVA's with repeated measures on condition, revealed that the MG-M condition produced significantly higher levels of confidence than the control condition. Levels of extrinsic motivation were highest in the MS condition.

The findings suggest that motivational imagery can serve a beneficial effect on physical performance in a controlled sport setting, and are discussed in terms of the processes potentially underlying the imagery effects. The applied implications of the results for both elite sports performance and exercise adherence are also highlighted.

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P10V-04

**A word of caution when inferring online control from variability in limb trajectories**

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*Keywords: on-line control, variability profiles, kinematic data acquisition*

Research has suggested that visual feedback is not only used to adjust limb trajectories during movement execution (online) but that visual feedback from a completed movement is used as an enriched form of KR to enhance the programming of subsequent trials (offline). In order to investigate the contribution of online and offline processing of visual feedback, researchers have examined the variability in distance travelled at various kinematic markers throughout the limb trajectory (e.g. peak acceleration [PKA], peak velocity [PKV] and peak negative acceleration [PKNA]). The rationale here is that if trajectories are programmed and not adjusted online, variability should increase as the movement progresses. However, if trajectories are being modulated online then variability profiles would deviate from those obtained when movement is programmed in advance. The purpose of the present investigation was to show how the form of variability profiles, and hence the degree to which online control is inferred, can be influenced by the kinematic data acquisition technique that is employed.

Participants performed horizontal elbow flexion movements to a target both with and without vision of the limb under two different criterion movement times (200 ms and 500 ms). Kinematic data were recorded using two different techniques. In the first, velocity and acceleration were obtained by differentiating displacement data obtained from an optical encoder. In the second, acceleration was obtained directly from an accelerometer.

The variability profiles for the 200 ms condition increased up to the end of the movement for the NV condition whereas in the FV condition, variability decreased from PKNA to movement end. In the 500 ms condition, variability profiles increased up to PKNA for both the FV and NV condition, but then decreased toward movement end with this decrease being greater in the FV condition. Comparison of the variability profiles also revealed that spatial variability at PKA and PKNA was greater when acceleration was derived from position data versus when it was obtained directly from the accelerometer. Hence, the degree to which variability decreased at the end of the movement depended on the kinematic data acquisition technique.

Therefore, when comparing variability profiles to infer whether visual feedback is utilised online or offline, careful consideration must be given to the acquisition technique from which the kinematic data is derived.

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## P10V-05

**Validation process of the Recovery Stress Questionnaire for athletes (RESTQ-Sport) in Portuguese language****Samulski Dietmar, Costa Leonardo, Kellmann Michael**

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*Keywords: questionnaire, stress, recovery*

The Recovery Stress Questionnaire for Athletes (RESTQ-Sport, Kellmann & Kallus, 1995) was developed to measure the frequency of the actual stress with the frequency of recovery-associated activities simultaneously. The actual stress state depends of the preceding stress and recovery activities. Using a simultaneous assessment of stress and recovery, a new picture of recovery stress state could be achieved. The specific characteristics of the RESTQ-Sport could measure evaluations of events; states and activities considering the frequency while simultaneously analyze the recovery-stress process. With 19 scales, the RESTQ-Sport assesses the potential stressful and restful events and their subjective consequences during the past three days/nights (Kallus & Kellmann, 2001).

The purposes of the present study were: To translate the RESTQ-Sport and to validate it in Portuguese language, analyzing the internal consistency of the scales, the intercorrelations between RESTQ-Sport scales, and the correlations between RESTQ-Sport and the Profile of Mood States (POMS).

A sample of 542 subjects participated in four different studies for checking internal consistency. One of them was also used for correlations analysis.

The results suggested that the internal consistency of the RESTQ-Sport progressed in different studies. A satisfactory reliability was attained for 16 of 19 scales (Alpha Cronbach > 0,70). There were significant results in the intercorrelation tests of the scales of the RESTQ-Sport and the correlations between the scales of RESTQ-Sport and POMS scales.

The present results agree with the validations of the RESTQ-Sport in the German and English languages. It was concluded that the RESTQ-Sport could be used as an important tool in the diagnosis and prevention of overtraining and burn-out in Brazil, for individual and team sports, as well as for the paraolympic sport.

## P10V-06

**Anxiety, physical self-concept, and nutritional habits among 15-18 year-old Hungarian females****Boros Szilvia, Sipos Kornel**

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*Keywords: anxiety, physical self-concept, adolescent females*

Grammar School students (113 females, N=113) between 15-18 years of age were examined by State-Trait Anxiety Scale (STAI-H/ FX1, FX2), Physical Self-Concept Scale (TENNESSEE Self Concept Scale) and Nutritional Description Test. Body Mass Index was also calculated.

The aim of the study was to describe and compare nutritional characteristics, anxiety values and physical self-concept at female grammar school students.

The anxiety values varied between 21 and 80. A- State mean = 40.22, SD = 11.71 (FX1), and between 30 and 64 A-Trait mean = 43.9, SD = 7.6 (FX2). The Tennessee Self-Concept Scale scores changed between 39 and 85. Mean = 63.9, SD = 10.1.

Those who were not satisfied with their appearance had higher trait anxiety value (FX2). Persons, who were easily tired, had low body weight and BMI and they were not active physically ( $p < 0.001$ ). They were characterized by consuming caffeine and a higher amount of food intake at dinner time ( $p < 0.05$ ). The higher proneness to anxiety for 15-18 year-old Hungarian females goes parallel with unfavourable eating habits and less physical activity.

## P10V-07

**A prediction function for identifying talent in 14-15 year old female field hockey players****Nieuwenhuis Carolina F, Spamer Emanuel J, Van Rossum Jaques HA**

Faculty of Educational Sciences, South Africa

*Keywords: field hockey, motor learning, talent selection*

Between 22% and 37% of participants between the ages of 13 - 15 are lost to different kinds of sport because they experience a lack of sufficient skills. Feelings of incompetence and the subsequent inability to compete effectively may end in non-participation. The importance of an effective talent identification programme may thus not be underestimated. The object of this study was therefore to identify kinanthropometric, motor- physical and psychological variables and specific field hockey skills that influence field hockey performance at the age of 14/15 years.

The two top girls' field hockey teams in the North West Province (South Africa) U/15 (under 15 age group) field hockey league (n=27), as well as the two teams who ended at the bottom of the league (n=25), were exposed to a test battery. In order to be able to put together the battery of tests, a task analysis was carried out in which the various factors which determine the various factors which determine performance in field hockey were taken into consideration. The battery of tests include game specific field hockey skills, physical-motor, kinanthropometric and psychological variables, all intended to assess female field hockey players in the 14-15 year old age group.

A statistical analysis of the data was done for descriptive purposes (x, s), and statistical significances between the successful and less successful players (p-values) were determined. Results indicated meaningful differences in some variables. A discriminant function was derived from the combined set of variables, in order to find out which combination of variables can be used to optimally distinguish successful and less successful players. Eight variables out of a possible set of 32 variables distinguish the female field hockey players in the 14/15 year old age group into two categories: 'successful' and 'less successful'. Two prediction functions were constructed on the basis of this analysis and in the original group of 21 successful players, three of the 21 players were incorrectly placed in the successful group and one of the less successful group was incorrectly placed; a prediction correctness of 90.5%.

## P10V-08

**Influence of instruction on velocity and accuracy of overarm throwing in novices**

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*Keywords: overarm throwing, velocity, accuracy*

This research investigated the velocity-accuracy relationship using novices and instructions that do not prescribe movement speed or accuracy in the absolute sense, but that merely require the subject to prioritise one of the requirements of the task.

Thirteen male subjects, novices in throwing were instructed to throw randomly from seven meters' distance at a target. This has to be done seven times under each of five instructions: V0) Throw as fast as possible (not instructed to aim), VA) throw as fast as possible and try to hit the target, VA) throw as fast as possible and hit the target, AV) hit the target and try to throw as fast as possible A0) hit the target. The target was a 0.5 x 0.5 m big blanket. Ball velocity and accuracy, expressed as mean radial error, consistency, centroid error and percentage of hits were measured.

A significant difference between velocities as a result of instruction was found. A significant difference in velocity between instruction V0 and the rest and instruction VA with instruction AV is shown. However, no significant difference was found in the accuracy in neither of the parameters among instructions VA to AV. Instruction V0 is taken out of further analysis on accuracy, because there was no aim on accuracy involved in it.

Instruction affected velocity. With increasing accuracy as the main priority, the velocity decreases, which is in accordance with a similar study on experienced throwers. However, in this study the velocity of the ball was significantly higher for instructions in which the main priority was velocity. This indicates that a different strategy was employed with these instructions. There were no significant differences between velocities from instruction VA, VA and AV indicating that in particular instructions emphasising both accuracy and velocity led to similar performance. In the study with experienced throwers only a significant lower velocity was found in instructions with accuracy as the main priority (AV and A0) indicating the role of experience.

The accuracy, however, did not improve when subjects were instructed to prioritise accuracy (see figure 1B). These results were inline with an earlier study with experienced throwers (van den Tillaar et al. 2003). An explanation for this finding could lie in the type of action. It could be that the subjects were more stressed when the only priority was accuracy. It can result in another type of throw, e.g. freezing degrees of freedom (Bernstein, 1967).

## P10V-09

**The relationship between expert and non-expert in information processing in darts throwing**

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*Keywords: psychomotor development, motor control, specificity*

Over the last 15 years researchers have tried to explain the differences between experts and non-experts in processing the acquired information by means of more cognitive "software" dimensions. In general, it has been shown that

expertise in more cognitive domains such as chess or solving of mathematical problems, is based on the acquisition of, the rapid access to, and the efficient use of semantically rich and, therefore complicated networks of domain-specific declarative and procedural knowledge (Neuman, O. 1996) This experiment is addressed to detect the differences between the expert and non-expert dart players in different kind of information processing. More detailed, we suppose the novice darts players use forward modeling mechanism for the precise anticipation of the required movement parameters, and on the basis of the provided parameters the movement will be executed by generalized motor program. Opposing to this, professionals use a special motor program, which includes the forward modeling mechanism, the feedback information mechanism, and the motor program mechanism to reach the highest performance level.

12 dart players participated in this experiment, throwing their darts in four different environmental conditions into the same target area. The additional information about the performance were continuously diminished from task by task, which means at the first (normal) condition, participants were allowed to use both visual and kinesthetic information during execution but at the last condition only the kinesthetic information was allowed to use.

According to our results, expert players were able to reach the same performance result due to special motor program. Opposing to this, non-experts performance were diminished from task by task.

This phenomenon must be caused by the difference in the information processing mechanism between expert and non expert players.

## P10V-10

**Effectiveness of an interactive internet program promoting physical activity: The feasibility of an internet-based, randomised study design**

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*Keywords: health promotion, internet, randomized trial*

www.active-online.ch is a freely available interactive website, offering an individually tailored counselling and motivation program for health enhancing physical activity. It is based on the Transtheoretical model of behaviour change and will be disseminated population wide with a multimedia strategy, in particular in collaboration with a large Internet portal. To estimate the public health impact of such a program, a randomised study of its effectiveness will be undertaken using the Internet as research setting. Because knowledge on Internet research in this area is scarce, a feasibility study is first conducted to quantify participant recruitment and dropout rates, to test Internet applications of measurements and to test an Internet-based randomisation procedure.

A randomized controlled trial is conducted on the Internet, using a study website designed for data collection and randomisation. Advertisements in two Swiss weekly magazines, banner advertisements on two Internet portals as well as an editorial call on the Internet homepage of a weekly magazine are published to announce an online health study and to invite interested persons to participate. Employees of one private company and one administrative unit are invited to participate directly by e-mail. On the study website, an online questionnaire is provided with an inherent algorithm to select eligible participants. After answering the online questionnaire, participants are randomly assigned to either

the physical activity promotion program [www.active-online.ch](http://www.active-online.ch) or to an interactive program on sun protective behaviour. After six weeks and after six months, participants receive an e-mail and are invited to answer a follow-up questionnaire on the study website via a given link in the e-mail.

Within 4 days after the publication of the print advertisements and banners, 300 visits were registered on the study homepage. 28% of them entered via Internet banners. 110 (36.7%) persons submitted the questionnaire (37% male, 63% female). Detailed data on participants' characteristics as well as results from e-mail recruitment will be presented.

Recruitment for an online study via advertisements is possible; a considerable proportion of visitors to the study website complete the questionnaire. In order to obtain a sufficient number of study participants, combined approaches will have to be used.

#### P10V-11

### **Netscape sports: co-parent of electronic leisure-uses, challenges, changes, and future directions**

**Hyatt Ronald**

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*Keywords: netscape sports*

The purpose of this presentation is to present the new uses of the Netscape in regards to sports, note the changes that are occurring in regards to the economics and ethical considerations about Netscape sports, and to present some recommendations and findings which sports organizations and sport sociologists are presenting as a means to investigate this phenomenon. Who owns the scores of college games and professional teams? Is sports information content overshadowing other major concerns about Netscape sports? What strategies are discussed and used in response to the challenges offered by Netscape sports?

The computer and the Netscape are co-parents of a new form of electronic leisure that is relatively new and pose opportunities and challenges for sports administrators and sport sociologists on a national and international level. On a global basis, users can gamble on sports, play fantasy games with electronically created teams, compete against other players from other nations in electronic games, be recruited by sports recruiters who have access to their recruiting data banks, and review sports scores on a twenty-four hour, seven days a week, 365 days (24/7/365) regimen. Access to information provided is in the present tense and is readily available. In 1983, the University of North Carolina at Chapel Hill and this writer hosted a conference on the beginning of this phenomenon which this writer identified as electronic leisure. A review of the literature in the field and casual scanning of the computer screen indicates that this phenomenon over the last twenty years has exploded both in scope and size on an exponential basis. New uses have been made of the computer and Netscape including information dissemination, instantaneous reporting, and exposure to a multitude of new sports and opinions about them.

Questions of ethics in sport, and the broader area of the philosophy of sport, have arisen in regards to Netscape sports and their use. Each category of use, such as fantasy games and fantasy league sports, has counter arguments regarding their use and abuse. This writer will present some of the changes, the challenges, and the strategies employed by other in regards to online gambling, fantasy games, video games, sports data bases, others.

#### P10V-12

### **Determination and comparison of anxiety and depression levels on the elite runners during one month residence in the Olympic conditioning camps**

**Hadji Rasouli Massoud**

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*Keywords: anxiety, running, depression*

The purpose of this study was the determination of psychological factors alteration during an acute training program on the long distance runners (L.D.R.s) and short distance runners (SH.D.R.s).

So this study has been done according to "before - after" procedure. Total subjects were 15 Iranian nation team runners (6 L.D.R.s and 9 SH.D.R.s). 3 samples of SH.D.R.s have been ruled out of study. The remaining samples were tested by B.D.I questionnaire during the first week of their stay in the camp and evaluated the anxiety and depression levels as "pre-test". After 25 days that all samples participated in the acute training programs the psychological test was repeated by Zoung questionnaire as post - test. Anxiety and depression levels have been measured and comprised. Alteration of these factors tested by Will-Cox on matched pair test.

The results showed that L.D.R.s had an increased level of depression which may be because by their prolonged and monotonous training and a decreased level of their prolonged and monotonous training and a decreased level of anxiety because they thought that they have enough time and chance for repairing their failures during the races ( $p < 5\%$ ) and opposite to this results, SH.D.R.s had an increased level of anxiety and a decreased level of depression ( $p < 5\%$ ) because of their interval training and unfortunately a few chances for repairing the failures during the races. These evaluations were calculated on pre-test samples psychological characteristic versus post test. One of the most interesting results of this research was that after two weeks of exercise reduction all of psychological indices return to normal levels. And so, it showed that jogging and endurance running is very useful for decreasing depression levels.

Track and field trainers should try to use many psychological methods for decreasing the anxiety level on the SH.D.R.s include: Mental training, relaxation and abdominal breathing to decrease the depression level on the L.D.R.s. Psychological training should include: Planning the variation of training programs and imagination on the gladly conditions.

#### P10V-13

### **Peculiarities of social skills among male school athletes and non-athletes**

**Sniras Sarunas, Malinauskiene Vilija**

Lithuanian Academy of Physical Education, Lithuania

*Keywords: social skills, training, athletes, non-athletes*

The present paper is to provide the analyses of the research problem how sport stimulates the formation of social skills, expands or limits personal ability to accept independent decisions, to express personal views and to say what you feel. The topicality of the work is based on the fact that research works commonly analyse the peculiarities of training social skills among school male athletes and non-athletes in the context of social training. The goal of our work is to reveal the peculiarities of social among school male athletes and non-athletes.

The work applied an adapted version of Samusevicha's questionnaire. The investigation was carried out in May 2001 at Kaunas Silainiai secondary school and tested 62 student athletes and 58 student non-athletes aging from 13 to 15.

The comparison of research results regarding school male athletes and non-athletes determined that statistically reliably differ according to the need to train the following social skills: to know oneself ( $p < 0.05$ ), to communicate and co-operate ( $p < 0.05$ ), to express personal opinion ( $p < 0.05$ ); the need of student athletes to train social skills is higher than the one of student non-athletes. Research results have proved that statistically reliably ( $p < 0.05$ ) differs the level of school male athletes and non-athletes aging from 13 to 15 in terms of the following social skills: ability to know oneself, ability to communicate and co-operate, ability to express personal opinion, ability to ask for help, i.e. the level of student athletes is higher.

Research data may be explained by the theory of constructive teaching, which emphasises the training of moral skills in the context of peers' interaction (Fairbrother, 1996; Gibbons et al., 1995; Pilz, 1995). Accordingly, we can make a presumption that sport schools, which provide conditions for successful children's activity, may expect a more frequent application of social skills the same being confirmed by our research data.

Fairbrother P (1996). *Nurse Education today* 16: 69 – 74

Gibbons S et al. (1995). *Research Quarterly for Exercise and Sport* 66: 12 – 17

Pilz G (1995). *International review of the sociology of sport* 30: 392 – 418

## P10V-14

### Theoretical and methodological aspects of information in conditions of modernization of the higher education

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*Keywords: higher education, sport education*

At the same time, process of introduction of information technologies in system of preparation of experts on physical training and sports is characterized by complexity and the ambiguity caused by the objective and subjective reasons among which it is necessary to allocate: absence of scientifically proved concepts and programs of information of the maximum sports education; insufficiently advanced material base, absence of the informational and environment in the majority of higher schools of physical culture; absence of the specific software, allowing to solve concrete applied tasks.

With the purpose of increase of efficiency and quality of higher education of experts and in connection with necessity of realization of the state educational standard of the higher education are developed:

- 1) Conception of integration of new pedagogical and information technologies in system of the higher sports education;
- 2) Model of study and methodical complex, programs and study and methodical complex common and special disciplines focused on use of information technologies;
- 3) A complex of computer programs of the educational and scientific assignment intended for support of educational process, study and research work;
- 4) Program and methodical maintenance (electronic manuals, laboratory practical works, algorithms, programs, didactic materials to educational employment, etc.); technology of designing of study and methodical materials in an electronic kind.

## Poster Session

### Psychology 2

### P10W

#### P10W-01

### An examination of peer relationships in sport as moderators of the association between self-presentational concerns and competitive trait anxiety

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*Keywords: youth sport, peers, friendship*

Recent research by Wilson and Eklund (1998) provides evidence of a strong relationship between self-presentational concerns in sport and competitive trait anxiety. This linkage is of importance because of the implications for both sport performance and athlete well-being. Perceived friendship quality and perceived peer acceptance are viable moderators of this relationship because of their conceptual and empirical tie to affect and provision of validation (Parker & Asher, 1993; Sullivan, 1953). Therefore, the purpose of this investigation was to determine if perceptions of friendship quality and/or peer acceptance in sport moderate the association of sport-related self-presentational concerns and competitive trait anxiety.

High school athletes ( $N = 230$ ; ages 14-19 years) from a variety of sports completed a multisection questionnaire containing reliable assessments of perceived friendship quality, perceived peer acceptance, sport-related self-presentational concerns, and competitive trait anxiety. Moderation hypotheses were examined using hierarchical multiple regression analysis (Aiken and West, 1991). Main effects (self-presentational concerns, friendship quality, peer acceptance) were entered into the regression model first, followed by the two-way interactions and the three-way interaction, respectively, in subsequent steps.

Although 41% of variance in competitive trait anxiety was explained by the predictors, significant change in explained variance was not obtained with the addition of interaction terms. Self-presentational concerns were the sole significant predictor of competitive trait anxiety, with higher concerns associated with higher anxiety. Thus, peer relationships appear to neither directly predict competitive trait anxiety nor moderate the relationship between self-presentational concerns and competitive trait anxiety.

Given the participants generally perceived positive peer relationships and low concerns and anxiety, it is possible that this finding stems from relative homogeneity of the sample of high school athletes. Findings may also stem from "level of

analysis" issues pertaining to the assessment of peer relationships.

Aiken LS, West SG (1991). *Multiple regression: Testing and interpreting interactions*, Parker JG, Asher SR (1993). *Dev Psychol* 29: 611-621, Sullivan HS (1954). *The interpersonal theory of psychiatry*, Wilson P, Eklund RC (1998) *J Sport Exercise Psy* 20: 81-97

#### P10W-02

### **Sportpsychological consultation work with elite athletes-the art of finding the balance between situational demands and scientific guidelines**

**Brandauer Thomas**

Institute of Sports Medicine Carinthia, Austria

*Keywords: elite athletes, consultancy, individualized approach*

This presentation takes a closer look at the specific needs of consultancy with elite athletes from a sportpsychological point of view. The focus is in particular on the gap between the athletes' expectations and their definitions of success regarding the counselling situation in comparison to those of the sports psychologist. In order to reconcile these differences successfully the sport psychologist needs to develop on the one hand a high degree of sensitivity and flexibility for the situational demands and on the other hand a well founded knowledge about his own counselling behavior. An individualized approach that stresses the athlete's strengths and weaknesses incorporating scientific knowledge that has already been tested and validated with other elite athletes is furthermore useful to meet the aims of athletes, coaches and sport psychologists alike.

#### P10W-03

### **Spomedial - sports medicine interactive learning: The development of an e-learning project**

**Platen Petra, Abel Thomas, Friedrich Thomas, Klose Christiane, Lalyko Vera, Machanek Andreas, Menz Claudia, Schneider Stefan, Wouters Edith**

Institute of Cardiology and Sports Medicine, German Sport University, Germany

*Keywords: e-learning, data base, sports medicine*

Without doubt, the benefits of new media include the possibility of data exchange via Internet across the world and the easy accessibility of data in digital format for any interested person. As a nation-wide education project spomedial follows the new possibilities of New Media: it's a high-quality web-based offer of contents of all areas of sports medicine as they are taught at German universities; enriched by various multimedia elements such as graphics, tables, photos, videos, 2d-, and 3d-animations, and simulations in digital formats, interactive diagrams and models. They were integrated in a combination of an internet author system and learning management system (NetCoach), whose central maintenance enables direct effects after changes. After staff was recruited, the technical infrastructure was built up including computer hard and soft ware as well as video- and photo equipment and even a scanner for 3-dimensional models. Intense communication between all cooperating universities concerning main aspects of structure, the specific spomedial style-guide, gender and media didactical and also legal aspects as well as evaluation procedures

accompany the content development. Besides the e-learning platform, a data base is set up where the digital material is stored. The final phase will focus on quality management and technical administration. In the sense of blended learning spomedial intends to combine aspects of online and face-to-face instruction: a) it supports self-paced and self-organized learning of students of sports sciences and human medicine as well as sports scientists and physicians engaged in further education as the major target groups for spomedial, b) teachers and tutors as further target groups will be able to prepare their lectures by making use of multimedia elements or to create online courses for the purpose of a "Virtual Campus". Although the financial support by the Federal Ministry of Education and Research will end in December 2003 after 2.5 years (approx. 2.61 Million Euro), the project will go on. Thus, the broad variety of learning sceneries of spomedial is aimed to serve as a basis of a web-based "Virtual European Sports Medicine University".

#### P10W-04

### **Relations between basketball players intelligence and their quality of play**

**Jakovljevic Sasha**

Faculty of Sport and Physical Education, Serbia

*Keywords: basketball, intelligence*

The aim of this study was to investigate the relationship between intelligence of basketball players and their quality of play.

The sample consisted of 80 senior basketball players (YUBA League), and 80 of the best Yugoslav juniors. Five independent judges estimated quality of the play of basketball players by one mark from 1 to 10. Intelligence of each player was estimated by 5 tests: D48, F1, F2, S1 and P1. In the latent space of intelligence only one factor was isolated. By using a t-test the differences between intelligence of seniors and juniors were investigated.

Results showed that seniors have higher scores in three independent variables: general intelligence, perceptive identification and structuralisation, and perceptive analysis and logical conclusion. A regression analysis was performed in order to find relations between intelligence of basketball players and the quality of their play. By a stepwise method following variables were noticed as important for the success: perceptive analysis and logical conclusion (seniors), and general intelligence (juniors).

#### P10W-05

### **Testing and special techniques for developing high-level fencers' training process**

**Abrahamyan Sergey**

Armenian State Institute of Physical Culture, Armenia

*Keywords*

Taking into account theoretical and practical preconditions as well as new rules in competitions on fencing, it is necessary to note, that special research of preparation is becoming urgent. One of the major parties of special preparation of fencers is the attacking actions.

With the purpose of the decision given to the problem as well as revealing the factors of jabs, (influencing accuracy) test exercises are made, which are divided into three groups: - Tests for definition of physical abilities; - Tests for definition of

psycho-motor abilities; - Tests for definition spatially-temporary characteristics of finishing attacking actions of the fencers.

Spatially-temporary parameters of prick(jabs) were registered with the help of the specially developed training device controlled by the computer program. Our training-arrangement consists of three targets, each of which is divided into six sectors. The device registers accuracy of jabs on sectors and time of performance of attacking action in milliseconds, with the subsequent opportunity of the mathematical analysis of the received data. 53 fencers from National Teams of Armenia, Georgia and clubs have taken part in the experiment. The data received during experiments have undergone correlation analysis.

The experiments have revealed that in accuracy of jabs fencers' influence vary: time of complex reaction, threefold jump from a place, tapping the test, wrist dynamometrics ( $p < 0.05$ ). The most essential interrelation of accuracy of jabs is observed with hard coordination by impellent actions with displays of dexterity (shuttle run and jab with lunge with action on the weapon, at  $p < 0.01$ ). The data are based on the received interrelations; the program consisting of three complexes of exercises, with regular employment of created training-machine was made educational training. The duration of the experiment lasted 3 months. In the end of the research the following data were received:

- The accuracy of jabs of the fencers was improved on 16mm.

- The time of performance of attacking actions (depending on complexity), was improved almost in one millisecond.

Generalizing the received material, it is possible to assert, that the techniques, invented by us, have revealed effective influence on process of developing of special preparation.

#### P10W-06

### Psychological and psychomotor factors associated with performance in golf

**Weigand Daniel A, Hemmings Brian, Metcalf Nick A**

University College Northampton, United Kingdom

*Keywords: golf, psychology, performance*

The purpose of this study was to extend the use of the Golf Performance Survey (Thomas & Over, 1994) with 158 male British golfers aged between 20 and 76 ( $M = 41.41 \pm 14.31$ ), categorised as a lower, middle, or higher handicap golfers (golf handicaps ranging from 1 to 28;  $M = 14.50 \pm 7.41$ ). Results of multivariate and univariate ANOVAs and Tukey's B post hoc analyses ( $p < .05$ ) revealed that the lower handicap, more skilled golfers, demonstrated (a) a more conservative approach than the higher handicap group; (b) less striving for maximal distance than the middle handicap group; and (c) greater mental preparation, higher levels of automaticity, greater putting skill, more incentive to seek improvement, and more commitment than either the middle or higher handicap groups. Results of a stepwise multiple regression analysis revealed the best predictors ( $R^2 = .57$ ) of a lower handicap included more incentive to seek improvement ( $\beta = -.34$ ), more years of experience ( $\beta = -.30$ ), lower age ( $\beta = .25$ ), greater automaticity ( $\beta = -.19$ ), greater commitment ( $\beta = -.16$ ), and greater putting skill ( $\beta = -.14$ ). The findings of this study are discussed in terms of the implications for mental skills training in golf.

McCaffrey N, Orlick T (1989). *International J. of Sport Psychology* 20: 256-278

Thomas PR, Over R (1994). *The Sport Psychologist* 8: 73-86

#### P10W-07

### An introduction to the persuasion of computer technology

**Galloway Shaun**

Semmelweis University, Budapest, Hungary

*Keywords: persuasion, captology, state sport confidence*

Becoming an applied sport psychologist can be a perilous career path as noted by Sachs (1992). This is in part due to the fact that there are more applied sport psychologists than opportunities. These opportunities are often times because the coach believes that there is little time for his athletes to develop these skills. A coach often will have time for physical preparation but little time for a structured psychological preparation. The purpose of this paper is to introduce a possible opportunity to use the power of technological persuasion to open the door to more traditional sport psychology services.

Fogg (2003) defines, "A persuasive computer as an interactive technology that attempts to change attitudes and behaviors in some way". I used the Visual Edge computer program and a laptop to test this measure of persuasiveness in regards to coaches ( $N=10$ ) opinions towards sport psychology services. I then measured the residual effects of the science of captology. As a further test of the power of behavioral change I tested the change in state self-confidence using Vealey's State Sport Confidence inventory SSCI (1986) on athletes ( $N=30$ ).

Results revealed that: (a) coaches were more open to technology services than traditional services; (b) That after being exposed to technological services the coaches were more open to traditional services and (c) Athletes state confidence levels were significantly improved after a visual edge session. While this study is an exploratory study in the area of computer technology persuasion the results have shown that computer technology might be a possible answer to provide opportunities in the area of applied sport psychology services.

#### P10W-08

### Cognitive and motor components of two different agility tasks

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Institute of Sport Science, University of Innsbruck, Austria

*Keywords: concentration, agility, variability of performance*

The ability to react quickly and adequate to movements of another sport participant or altered surrounding conditions plays an important role for elite sport performance. To check reaction times in more sport specific conditions a special test (agility-test, sporting version) was constructed, where signals on a computer screen are answered by jumps onto corresponding fields. This study investigates the impact of concentration and jumping power on the agility test scores.

38 male and 23 female students performed the isolated form (long intervals between signals) and reactive form (short intervals) of agility test. Four series with 20 trials each were performed (test score: the best of the series 2, 3 and 4). Jumping power was measured with a standing long jump. Concentration was measured with an attention-strain test (d2-test by Brickenkamp).

For the male and female students a highly significant ( $p < 0.01$ ) correlation between the two forms of agility tests can be seen. In addition to that the female students showed a highly significant correlation between the standing long jump and the agility test with isolated jumps ( $r = -0.58$ ). A repeated

measures analysis of variance was calculated for the factors attention and gender for the dependent variables of the four trials of isolated and reactive agility test respectively. Standing long jump scores were taken as covariate. The difference between the high attention-strain group and the low attention strain group turned out not to be significant, just like the interaction of attention group and gender. Adequate motor reaction should be tested within a motor task. The question is, whether a basic ability of agility exists and brings advantages for sport specific situations. This study showed that for female students a motor ability component determines agility test scores. It can also be seen, that the two different protocols (reactive jumps and isolated jumps) of the agility test can be distinguished by different impacts of jumping power by female students. Attention-strain-reactions of the students do not influence their agility test scores.

#### P10W-09

### The role of metacognition in sport: an under-researched area

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*Keywords: metacognition, problem solving, intervention*

The purpose of this paper is to draw attention to an under-researched area concerning the role of metacognition in sport. Metacognition has been described as "having knowledge or awareness of one's own cognitive processes" (Statt, 1998). This ability underpins both monitoring and control mechanisms in human thinking (Nelson & Nahren, 1994). Although extensively researched in the realm of education and learning (Hacker, Dunlosky & Graesser, 1998), very little research has tried to operationalise the concept of metacognition within the realm of sport. As improvements in sport performance involve self reflection and self regulation strategies, measuring levels of metacognitive activity inherent in athletes would therefore appear to be beneficial - especially when considering the nature of performance interventions.

The paper suggests how the highly metacognitive task of problem solving (Davidson, Deuser & Sternberg, 1994) might be coupled with a range of measurement protocols. These include: ratings and predictions of understanding, measures of behavioural correlates, error detection paradigms and retrospective/introspective approaches. Methodological and theoretical implications of potential research in this area are also discussed.

*Fry PS, Lupart JL (1987). Cognitive Processes in Children's Learning; Practical Applications in Educational Practice & Classroom Management, 184-189.*

*Greene J (1987). Memory, Thinking & Language.*

*Hacker DJ, Dunlosky J, Graesser AC (1998). Metacognition in Educational Theory & Practice Lawrence Erlbaum Associates.*

*Osbourne J (2001). Measuring Metacognition in the Classroom; A Review of Currently Available Measures Unpublished manuscript.*

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*Statt DA (1998). The Concise dictionary of Psychology (3rd ed.).*

#### P10W-10

### Coeducated sporting and its psychological effects

**Majoross Kinga**

Semmelweis University, Budapest, Hungary

*Keywords: mental health, co-education, korfball*

Coeducated sporting is a neglected research area in both the international and the Hungarian literature, although its importance is outstanding in P. E. lessons in schools, as well as in leisure time sports. The results of research are controversial; there are several arguments for and against coeducated sporting. The goal of my research is to uncover the connection between coeducated sporting and mental health.

I compared korfball and basketball players (the former is a coeducated ball team sport, the latter is a same sex ball team sport; both involve basically similar physical activity). Sample: 50 students from both groups (altogether 50 men and 50 women, N=100) were questioned, all of them do their sports as a hobby (5-10 hours a week on average). The research method consisted of two parts: (a) questionnaire (aggression, anxiety, jealousy, group affiliation, group environments, ego and task orientation questionnaires and open-ended questions) and (b) an observation (the number of fouls in matches was recorded).

The results showed a statistically significant difference on almost all variables between the two sports. The mixed format (korfball) involved less aggression ( $p < 0.05$ ) according to both the survey and the observed features (the number of fouls in matches) as well. Besides this, the coeducated group was characterised by a lower level of anxiety ( $p < 0.001$ ) and jealousy of other team members ( $p < 0.001$ ). At the same time, korfball players obtained significantly higher levels in self-confidence ( $p < 0.05$ ), co-operation with other team members ( $p < 0.05$ ), group affiliation ( $p < 0.001$ ) and group cohesion ( $p < 0.001$ ).

All this means that the coeducated sporting results in better mental health parameters, which is of paramount importance pedagogically.

#### P10W-11

### Psychophysiological approaches to clinical depression: a way forward

**Morres Ioannis**

Catholic University Leuven, Belgium

*Keywords: exercise, perceived exertion, clinical depression*

Despite research attempts aim at providing evidence that exercise causes a decrease of depression the issue of causality is considered as premature (Dunn, Trivedi, & O'Neal, 2001). Exercise dose is an important factor in support of causality (Biddle & Mutrie, 2001) and no concept for the therapeutic application of exercise in psychiatric settings exists (Meyer & Brooks, 2000). Nevertheless, prescribing exercise intensity for depressed patients is a challenging task. The heterogeneous morbidity characteristics reveal differentiated and adverse psychosomatic responses towards exercise psychophysiological demands/outcomes. An effort sensing mechanism is proposed to conceptualise exertional experiences and to set the intensity within a perceptual preference. The rating scale (6-20) of perceived physical exertion (Borg, 1998) captures preferred fitness intensity, establishing a balance between the optional physiological dosage and a comfort cathexis. Training by subjective measures minimizes inverse factors to participation.



A submaximal graded exercise testing with a physiological reference to blood lactate measures is suggested in order to plot the workload of the preferred exercise intensity amongst depressed patients (Meyer & Brooks, 2000). The blood lactate inflection points (values > 1.0mmol/L = resting levels) are markers of the transition from moderate to heavy-uncomfortable exercise. However, it is suggested that the preferred intensity evaluation be implemented under the taxonomy of depression symptomatology. Taking that the perceived physical exertion is a psychophysiological mechanism with detected intervariability into consideration, this involved symptomatological discerning may address exertional rankings analogous to the nature of the psychopathological psychomotor-somatic status. Comparisons of various conditions signify an early stage in the maturation of a field of study, broadly defining pertinent parameters.

There are no data available. The current report represents a preliminary approach into the psychophysiological analysis of depression corresponding to a future Ph.D. proposal.

*Biddle SJH, Mutrie N (2001). Psychology of physical activity: determinants, well-being and interventions*

*Borg G (1998). Borg's perceived exertion and pain scales*

*Dunn AL et al (2001). Med Sci Sports Exercise Vol 33: S587-S597*

*Meyer TF, Brooks A (2000). Sports Med Vol 4: 269-79*

#### P10W-12

### Some technical and psychological factors of succesful field crossbow shooting

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Semmelweis University, Budapest, Hungary

*Keywords: psychology, crossbow, technical analysis*

The Hungarian crossbow team was examined to determine the technical and psychological parameters, which could play an important role in good competition results. Our question was how the competition result of the shooters can be influenced by the technical parameters of equipment and psychological characteristics.

Ten elite field crossbow shooters were investigated in the study. The examination was divided into three parts. The first part was the monitoring of the adrenaline and noradrenaline changes during a two day crossbow competitions. The second part was a technical analysis of the equipment (4 type) and the measurement of the shooters. They shot 10 bolts, with their crossbow. We measured the heart frequency (Polar) and the body stability (Kistler force plate). With optoelectronic training and analysing system (Noptel) we measured the aiming movements. The third part was the complex psychological examination, which included the following: STAI- FX1, STAI- FX2, AAI-H, SLM, CPI, PISI, ACSI-28/2.

Results showed a significant correlation ( $p < 0.001$ ) between holding ability within ring 9 and holding ability COG ring 10, holding ability within ring 9 and 10 ( $p < 0.01$ ), horizontal and vertical aiming movement and body sway ( $p < 0.05$ ) in case of the best equipment. With the wrong constructed crossbow the shooters have triggering failure, and higher heart frequency ( $p < 0.05$ ) with the 3. place equipment, ( $p < 0.001$ ) and the 4. place equipment. There was correlation between the competition result and the ability of Coping with adversity (ACSI-28/Factor1), Synchronization (PISI/Factor12), Success orientation (SLM/Factor4), Stress tolerance (SLM/Factor5) ( $p < 0.05$ ). The examined shooters were divided into two groups according to their results (Olympic scores). The following characteristics showed significant differences

( $p < 0.05$ ) between the two groups: intellectual efficiency (-) (CPI/IE), emotional control (PISI/Factor15), MVV and epinephrine level after the first competition day (-). A tendency like correlation was found in empathy (-) (CPI/EM), feeling of control (PISI/Factor2), ability of social mobilization (PISI/Factor10) and synchronization (PISI/Factor12).

The results showed that in field crossbow shooting the technical level of equipment is very important. This can influence the holding ability and the economy of shooting. The best shooters have good coping ability, synchronisation, success orientation, stress tolerance and emotional control.

#### P10W-13

### Emotion regulation in elite and pre-elite athletes

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*Keywords: IZOF, emotion, self-regulation*

The athlete's ability in obtaining optimal state for competition is a crucial factor for best achievements. The Individual Zones of Optimal Functioning (IZOF) model provides a sound emotion-performance conceptualisation for the development of self-regulation strategies. Intervention for emotion self-regulation initiates by fostering the athlete's awareness on how different contents and intensities of competition emotions exert facilitating or inhibiting effects. Afterwards, self-regulation is applied to recover optimal emotions and emotion-related bodily symptoms, and then modulate (increase or decrease) the intensity of emotions and symptoms. A variety of individualised strategies are employed to recover facilitating states. These include competition routines, physical and technical warm-up, relaxation procedures, energising techniques, imagery, self-talk, and self-evaluation of emotional states and bodily symptoms. Energising and de-energising, cognitive- and bodily-oriented techniques are then applied to increase or decrease emotion and symptom intensities. For example, realistic goals, task specific imagery, positive self-talk, and somatic relaxation are effective in lowering intensity of emotions and symptoms. Conversely, challenging goals, mastery imagery, pep-talk, energising breathing, and muscular tension are useful in enhancing intensity of emotions and symptoms. To develop most effective self-regulation strategies, future intervention studies should explore the whole range of psychobiosocial states (i.e., emotional, somatic, cognitive, motivational, motor-behavioural, and communicative) incorporated in the IZOF model.

#### P10W-14

### Competitive trait anxiety among junior athletes: differences between contact and non-contact sports

**Calu-Leoca Simina, Mita Bogdan**

National Institute for Sport Research, Romania

*Keywords: anxiety, SCAT, contact sports*

The purpose of this study was to examine the levels of trait anxiety in different sports and to investigate whether there are any differences between sports that necessitate a contact with the opponent and non-contact sports. Previous research (Simon and Martens, 1977) has found that competitive state anxiety is higher for athletes in individual sports compared to

athletes in team sports. It has also been found (Lowe and McGrath, 1971) that participants in individual non-contact sports report lower levels of state anxiety than participants in individual contact sports.

Anxiety was measured using the Sport Competition Anxiety Test (SCAT) (Martens, Vealey and Burton). The SCAT is a self-report scale, a 15-item questionnaire asking the subjects how they generally feel when they compete in sports and games. The SCAT is scored on a three-point Likert scale (1= Hardly ever, 2 = Sometimes, 3 = Often), from a possible 10 (that indicates low trait anxiety) to 30 (score that indicates a high trait anxiety). Subjects were 85 young athletes (33 girls and 52 boys) competing in four sports, with an age range between 13 and 19 years. Independent t-tests were calculated for each null hypothesis by using the SPSS software.

The results indicated that there was no statistically significant difference between the trait anxiety scores of athletes in contact and non-contact sports, but revealed differences between individual and team sports and gender differences. The athletes' trait anxiety scores in individual sports ( $M=21.19$ ,  $SD=3.94$ ) were higher than the team players' scores. ( $M=18.03$ ,  $SD=4.32$ ). These results are consistent with the findings of Simon and Martens (1977) that indicated higher trait anxiety in individual sports than in team sports.

These sport and gender differences observed in the study indicate the need and importance of developing specific and personalized interventions, tailored to individual needs. The results of the study failed to prove the hypothesis that athletes in contact sports have greater trait anxiety than athletes in non-contact sports.

#### P10W-15

### Connection between cognitive abilities: Reaction time and motion anticipation

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*Keywords: age, reaction time, motion anticipation*

According to the theory of functional systems (Anokhin, P.K., 1970) RT and the motion anticipation could be viewed as a whole in performing the acts of movement. In many fields of sport the defining role in achieving results is played by the aspect of cognitive abilities of psychological preparation. Precise and fast extrapolation of motion anticipation on the basis of visual information from the short term motion vision is important in sports games, in single combat, shooting, fencing, alpine skiing, cycling and driving, etc.

Studies have shown that from the age of 20 to 60 RT is lengthened 25% and it is caused by the anatomical and physiological changes in the central nervous system (Tilvis R, Sourander L 1993).

The aim of the present research was to study the dynamics of the motion anticipation depending on age. The motion anticipation and RT of 96 persons between the age of 20-65 were measured. The method used in the research was "WinPsycho 2000" which enables to determine the quickness and correctness of the motion anticipation during the demonstration of the test, the subject first had to memorise the speed of motion on the display of the personal computer and next, to compare the speeds of motion presented in the course of the test at the shortest time and with maximum correctness with those displayed during the test demonstration (Thomson K. 2001).

In the present study the results of group comparison did not indicate statistically reliable discrepancies in the motion anticipation of different ages.

As there is no connection between the age-determined lengthening of RT and the decline in the motion anticipation in our pilot research, it can be concluded that different cognitive abilities have in ontogeny different dynamics. Therefore, it can be assumed that while carrying out acts of movement requiring the high rate of RT and the motion anticipation it is possible to maintain the quality of action on the level of cognitive abilities due to the compensating impact of the components of the motion anticipation.

Anokhin P K (1970). *Usp. Fiziol. Nauk*, 1: 19-54

Thomson K (2001). *FEPSAC Bulletin*, Vol 13:2-7

Tilvis R, Sourander L (1993). *Geriatrics*

#### P10W-16

### The effects of different types of physical activity on neuropsychological tests on healthy older male subjects

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*Keywords: elderly, physical exercise, cognitive function*

It has been well-documented that the aging process is accompanied by deterioration of cognitive functions, such as memory, attention, reaction time and speed of information processing. The literature to date suggests a positive relationship between physiological indicators of physical fitness (such as aerobic capacity) and indices of cognitive performance. Habitual physical activity has received much attention as a potential protective factor for neurocognitive functioning. The aim of the present study was to verify the possible influences of different types of physical activity on neuropsychological tests on healthy older male subjects.

Sixty volunteers of 60 to 70 years ( $64.65 \pm 3.56$  years), of which 17 female were sedentary (control group), 23 female participants participated in an exercise program (experimental group) and 20 male/female participants engaged in leisure activity. The volunteers were submitted to a basic evaluation (tests of maximum effort with electrocardiogram and neuropsychological tests - memory, praxia, visual-space, construction, agility (hands), mental agility, attention, verbal fluency and general intelligence). After evaluation the experimental group participated in a program of physical conditioning with prevalence in the aerobic metabolism, that consisted of a walk three times a week, with a duration of 60 minutes, as complemental activity flexibility exercises were accomplished.

The results revealed that the experimental group improved significantly in attention, memory, motive agility ( $p < 0.05$ ), and showed also significant increase in peak oxygen consumption ( $Vo_2$  peak). The other groups decreased significantly in all variables.

Cognitive function may be influenced by different types of physical activity and participation in a systematized physical aerobic conditioning program can be an interesting therapeutic option for the cognitive improvement in older.

P10W-17

**Motivational factors and coping strategies among athletes with disabilities and able bodied athletes**

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*Keywords: motivation, strategy, handicapped*

In my research I study the individual and situation motivational factors, coping strategies among able-bodied athletes and athletes with disabilities. The participants of the research are volleyball players who take part on the National Championships in Hungary and also disabled volleyball players, who compete in the Middle-European Region of European Volleyball League and elite fencers and fencers in wheelchairs from Hungary.

Does the task orientation appear in the coping strategy of Hungarian disabled athletes?

What kinds of coping strategy do disabled athletes use?

Are disabled athletes characterised by task or ego orientation?

Is there a difference in the motivational climate between groups of athletes?

Measurements:

1. Coping and coping potential on the basis of the given methods, COPE (Oláh, 1993).
2. Making new questionnaire (Hungarian version) according to the English version PMCSQ (Perceived Motivational Climate in Sport Questionnaire Perceived Motivational Climate in Sport Questionnaire) and TEOSQ, (Pensgaard 1999).

On the basis of the results of earlier researches the able-bodied and the disabled athletes have different motivational climate. One of the reasons is the extreme media focus in the sports events, after all the public attention has an enormous pressure on the athletes, on their performance. This effect attends much less among disabled athletes. On the basis of all these probable that disabled athletes would perceive a more mastery-oriented climate and able athletes would perceive one of performance. Among athletes with disabilities there is more difference than able athletes, therefore in work of them coaches the personal treatment is better succeeded.

P10W-18

**Canonic discriminative analysis of cognitive dimensions handball players of different ranges of competition**

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*Keywords: handball, cognitive abilities*

Cognitive abilities are strongly related to concrete situations in handball games, because the integrative development can bring the favourable sport result, also victory. The aim of this study was to determine a discrimination of cognitive abilities in advance defined handball groups at one time point.

Based on a chosen mathematic-statistic model and assigned aim, we choose to include 180 examiners into sample divided in three sub samples considering rang of competition. In order to cover representatively basic psychological abilities, the following measurement instruments were, chosen, in accordance with the cybernetic model of cognitive processing of information: IT-1, S-1 and AI-4. To determine cognitive differences of handball players from different ranges of competition, a standard and stepwise method of canonic discriminative analyses was applied.

Results are showing that the tested players, considering the rang of competition, are significantly different. Looking at results we can see that the discriminative function separates players based on the test S1 for estimation of efficiency of spatial relations. This factor is actually a subordinated mechanism, responsible for determination of a relation between elements of some structure and their important characteristics of those structures in resolving problems which are previous obtained information's independent. It is a famous mechanism for parallel processing. Based on size and omen of centroid projection on first discriminative function, it can be concluded that the handball players of the first division have better abilities to determine inter-element relations of some structure and necessary characteristics of those structures. This factor is appropriate to the Cattell factor of fluid intelligence.

Handball is a sport game in which result depends on technique and abilities and also on resolving complex tactical aims. Momirovic, Gredelj and Horga determined that the sport success depends on better adaptation of cognitive abilities, especially by high rang. Obtained results, go in favor to assumptions of Rushall, Bushana, Agarwala and others, in which stands that sport players are not that different in cognitive abilities and person characteristics by kind of sport but on obtained sport success., Canonic discriminative analysis of cognitive dimensions handball players of different ranges of competition.

## Poster Session

## Psychology 3 - Computer Science 2

P10X

## P10X-01

**A pilot study of physical activities participation in relation to youth risk behaviour****Sum Kim Wai, Chan Wan Ka**

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*Keywords: physical activity, youth risk behaviours, mental health*

Participation in physical activities is known to be beneficial to health. Attitudes and behaviours developed in early adolescence have health consequences that continue into adulthood. The purpose of this pilot study was to investigate physical activities participation in relation to youth risk behaviours.

Forty students from 12-18 years of age were selected for this study. The Physical Activities Against Youth Risk Behaviours (PAAAYRB) survey was self-administered. The questionnaires collected demographic data. Questionnaire content covered the followings: 1. Physical activity participation levels; 2. Youth risk behaviours: (i) unintentional injury; (ii) intentional injury; (iii) suicidal tendency; (iv) tobacco use; (v) alcohol use; (vi) other drug use; (vii) sexual behaviour; and (viii) unhealthy dietary behaviour.

Within the scope of this study, the following findings were derived:

1. Over 60% of the respondents have always been taking part in organized sport activities and school/community sports teams.
2. Low violence behaviour was found.
3. Only 5% of the respondents felt sad or hopeless and no respondent was considered attempting suicide.
4. Over 90% and 70% of the respondents answered that they have had neither had a cigarette smoking nor a drinking habit.
5. Though 2.5% of the respondents answered that they have tried cocaine/marijuana during their life and 7.5% of the respondents have bought or received an illegal drug on school property, the use or intake of illegal drug rates were indicated very low.
6. Over 85% of the respondents answered that they have never had sexual intercourse experience.
7. There were no respondents answering that they were fasting, taking any diet pills, powders or liquids without a doctor's advice and vomiting or taking laxatives to lose weight or to keep from gaining weight.

The relationship between physical activities and youth risk behaviours had not been thoroughly investigated in the region in the past. The investigators of this study preliminary discovered that if adolescents actively and regularly took part in physical activities they would have a relatively low risk behaviour. A thorough investigation of this study with larger sample size for grouping sample differences is encouraged. In addition, a comparison study between different countries and cultures should also be conducted in the future.

## P10X-02

**Motivation for sport in competitive older adults****De Pero Roberta, Amici Stefano, Benvenuti Cinzia, Capranica Laura**

University Institute of Motor Sciences, Italy

*Keywords: motivation, competition*

Many researches emphasized the age- and gender-related differences in intrinsic and extrinsic motivations associated to sport participation in sport motivation (Gill 1996; Campbell et al. 2001). Recently, active older adults are increasing in western countries populations and it becomes crucial to identify their motivation, to develop appropriate strategies to maximize adherence and effectiveness of sport programs. Thus, the aim of the present study was to investigate the intrinsic and extrinsic motivations for adults' participation in sport with reference to gender.

430 track and field athletes (348 males and 82 females) were randomly pooled to represent the total adult athlete population (error <4%). They were divided into three age groups (45-55 yrs; 56-65 yrs; >66). A sport motivation scale (SMS) questionnaire (Pelletier et al., 1995) was administered to assess the reasons of sport participation. The Cronbach's alpha reliability coefficient was used to test the internal consistency of SMS. A 2 x 3 (gender and age groups) MANOVA with motivation (intrinsic and extrinsic) and amotivation dependent variables was applied to test significant differences ( $p < 0.05$ ).

The sample showed alpha coefficients ranging from 0.70 (identified) to 0.85 (stimulation). MANOVA showed a significant main effect for age ( $p < 0.01$ ) only. Significant univariate age differences were shown ( $p < 0.01$ ) for extrinsic motivation only. Tukey's post hoc showed significantly lower values of the younger group with respect to the other groups (45-55 yrs =  $47.64 \pm 10.20$ ; 56-65 =  $51.17 \pm 11.05$ ; >65 =  $53.54 \pm 11.69$ ).

In agreement to literature on younger subjects the SMS showed adequate internal consistency coefficients, indicating that this instrument is valid for older population too. As expected, gender differences seemed to be reduced or eliminated in elite athletes (Vealey 1986) and in older populations (Gill et al. 1996). Since the subjects practiced track and field for at least 10 years, the intrinsic motivations were not crucial factors to determine sport adherence. Instead with increasing age, extrinsic motivation seemed a more important factor (Hellandsig, 1998).

*Pelletier L G et al (1996). J Sport Ex Psychol, 17, 35-53.*

*Gill D L et al (1996). J Sport Behav, 19, 307-318.*

*Campbell P G et al (2001). J Sport Ex Psychol, 23, 191-199.*

*Vealey R S (1986). J Sport Psychol, 8, 221-246.*

*Hellandsig E (1998). Int J Sports Psychol, 29, 27-44.*

## P10X-03

**Gender differences in the psychological correlates of fear of injury in gymnasts: an Italian study**

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University Institute of Motor Sciences, Italy

*Keywords: self-efficacy, fear of injury, gymnastics*

The role that psychological factors play in influencing an athlete's performance is a topic, which has been receiving increased attention in the sport psychological literature. In the present study, we examined fear of physical injury among gymnasts at varying technical levels of expertise or competence. We also investigated gender differences in gymnasts' fear of physical injury and in its relations with anxiety and self-efficacy for motor performance.

Subjects for this study comprised 186 gymnasts (83 males and 103 females) ranging in age from 8 to 19. The sample was divided in 4 groups based on the age and 2 groups based on the technical level. Specific questionnaires were used to measure physical self-efficacy (SEM-S by Bortoli et al., 1996), anxiety levels (Anxiety scale by Busnelli et al., 1974) and fear in gymnastics (Gymnastics fear inventory). This questionnaire was developed for this study on the basis of a focus group.

We first performed a MANOVA to examine possible gender, age, and technical level differences in the mean levels of fear, anxiety, and physical self-efficacy. Then we performed correlations among the three dependent variables.

The results found that Italian female gymnasts were more anxious and felt less confident to do well in a physical performance than male gymnasts. This finding is quite in line with research that has highlighted the role of differing cultural norms between genders and that has documented how males receive more encouragement in sport than females from every family members, peers, teachers, and coaches (Giuliano et al., 2000). Despite its apparent inconsistency with these results, the additional finding that male and female gymnasts did not differ on their average levels of fear for physical injury did not seem so surprising, in retrospect. The physical risks associated with the sport of gymnastics are particularly evident to whoever wants to practice this sport and, as such, gymnastics probably tends to attract athletes who are willing to overcome these risks. This may explain the lack of gender differences in fear. The correlations were all in the expected direction, suggesting that fear of physical injury may in part significantly rise in athletes who tend to experience anxiety and who do not have or engage in self-reassuring cognitions about their own abilities.

Giuliano T A (2000). *Sex roles*, 42, (3/4), 159-181Moritz S et al (2000). *R. Q. E. S.*, sep: 280-288

## P10X-04

**Comparative research between female handball and basketball players in some functional dimensions**

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*Keywords: handball, basketball, functional abilities*

Results and comparison between top handball and basketball players indicate a higher level of basic aerobic power of basketball players. Handball players are dominant in anaerobic power and capacity. These findings could have a basis in the different structure of movement in handball and basketball, which requires a specific training of functional

abilities for each game. Reason for such results could be also seen in some of the characteristics of our sample (number of players, level of selection etc.) and especially in the level of basically preparedness of handball and basketball players.

## P10X-05

**Participation motives and competition experience: their relationship in youth basketball training**

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*Keywords: basketball, youth, participation motives, competition exercise*

This study investigated the interrelationship between participation motivation (reasons given for involvement in training) and competition experience (participation in games and winning %) in youth basketball training.

The participants were 24 girls aged 11-13 years from the basketball club "Kolibri". The girls completed the Participation Motivation Questionnaire (PMQ; Gill et al., 1983), a 30-item list of possible reasons for children to participate in sport. A 5-point Likert scale was used. Responders answered to the statement: "I participate in sport because ...", indicating their preferences from 1 ("not at all important") to 5 ("extremely important"). Then a correlation analysis was used to find relationship between participation motivation and competition experience amount of games in which they participated and their winning percentage was recorded.

Results show that young female basketball players' who focus more on games participation motives tend to be more Skill/Competition and Status/Recognition oriented. However, the combined participation motivation and winning percentage makes the picture slightly less clear. It shows that players with higher winning percentage tend to be more Fitness, Status/Recognition, Team Atmosphere oriented. They like the coach more, perhaps because there are different coach reactions after winning and losing. But it shows that athletes begin to play for extrinsic rewards. In this situation coaches should continually let athletes know by word and deed that extrinsic rewards are only tokens of recognition for achieving the larger goal of acquiring and performing sport skills (Martens, 1997). Results show that winning is also motivationally positive as it enhances athletes satisfaction during exercise ( $p < 0.05$ ).

## P10X-06

**Revalidation of sport competition anxiety test on Greek junior badminton athletes**

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*Keywords: anxiety, badminton, competition*

Individual differences in competitive trait anxiety, or the tendency to perceive competitive situations as threatening and/or to respond to these situations with elevated state anxiety, might literally influence an athlete's game quality. The aim of this study was the revalidation of the sport competition anxiety test (Greek Version) on junior Greek badminton players.

The sample consisted of 56 Junior Greek athletes between the ages of 11-17 years old, during the 2002 Greek Men and Women Open National Junior Badminton Championship Tournament. The instrument that was used was the "Sport

Competition Anxiety Test" Greek version (Zervas, Kakkos, 1990). The athletes completed voluntarily the questionnaire. The results showed that all 3 factors of the questionnaire characterized by acceptable internal consistency that is, all of them the Cronbach's alpha is higher than .62. One-sample T-test indicated statistical significant differences for "Relaxation"  $t(55)=22$ ,  $p<.001$ , for "Anxiety"  $t(55)=26,10$ ,  $p<.001$  and for "Psycho-somatic anxiety symptoms"  $t(55)=29,26$ ,  $p<.001$ . More specifically, the athletes presented highest scores on "Relaxation" ( $M=2,01$ ,  $SD=0,69$ ), right after on "Anxiety" ( $M=1,83$ ,  $SD=0,52$ ) and finally on "Psycho-somatic anxiety symptoms" ( $M=1,67$ ,  $SD=0,43$ ).

In conclusion the results proved that the Greek version of the SCAT questionnaire (Martens, Vealey, Burton, 1990) is an appropriate instrument that can help coaches and especially athletes obtain very essential and practical information that might help them reduce competition anxiety symptoms.

Martens et al (1990). *Competitive anxiety in sports*, (pp. 3-115). Champaign, IL: Human Kinetics Publishers, Inc.

Zervas, G., Kakkos, V. (1990). *Sport Psychology*, 4: 3-24.

### P10X-07

#### The education of the attitude towards winning in football players aged 13-14

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*Keywords: football, psychological training*

The importance of the education towards the attitude of winning especially with young football players is obvious. Therefore the trainer should choose only those children who possess the positive traits of characters to be a good athlete. Skill is not enough; you need to have the right temperament.

The psychological training session, focused on improving the attitude towards winning lasted 20 minutes and it was done before each football training session with 13-14 year-old footballers (born 1989). The experiment started on August 5th 2002 and finished at the end of October 2002. The "witness" group consisted of schoolboys at School no.21, Craiova. They had been selected at random. The first testing was carried out at the beginning of the period of training and the final testing as well as the testing of the children in the "witness" group was carried out in the middle of the competition period.

The initial testing of the experimental group

-> 14 players have positive attitude towards winning;

-> 1 player has excessive attitude towards winning;

-> 5 players are oriented towards abandonment.

The final testing of the experimental group.

-> 19 players have positive attitude towards winning;

-> 1 player has excessive attitude towards winning.

Testing the attitude towards winning on the group of schoolboys (the "witness" group).

We can notice the presence of the four types of attitudes inside the group. The session of psychological training have lead to the improvement of the attitude towards winning, as all the players oriented towards abandonment in the experimental group has got the attitude of winner. After psychological selection the team should consist mostly of players with positive attitude of winner. Although at the beginning, the sessions of psychological training seemed boring to players, they became a necessity at the end of the experiment. The experimental group of football players is more homogeneous than the group of schoolboys.

Epuran M, Holdevici I, Tonita FI (2001). *Psihologia sportului de performanta*, Ed. FEST, Bucuresti

Aradavoia Gh, Popescu St (1998). *Autocunoasterea personalitatii*, Ed. Antet, Oradea

### P10X-08

#### Motivation and personality traits of senior oarsmen of different levels

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*Keywords: motivation, rowing, personality traits*

Motivation and personality traits of senior oarsmen of different level.

The rowing practice is rich with examples when the rowers with equal or approximate motoric and techno-tactical qualities achieve different results. This fact points to a supposition that certain psychological dimensions can influence the success in sports a lot. Searching for the typical and general characteristics of sportsmen has an applicative value, since it enables reliable determination of the most important psychological dimensions of a person.

Purpose of the study was to examine possible differences in motivation and personality traits between sportsmen of different level.

During ten years (1993-2002) seventy-six senior oarsmen were examined in the areas motivation and personality traits. Whole sample was divided into three groups according to sport success (41 national rowers (NR) who didn't reach national team, 24 members of Croatian national teams (international rowers (IR)) who took part in World Championships as well as a group of 11 young oarsmen who won medals at World's (MR)). Three instruments were applied on the sample: 1) The General achievement motivation questionnaire (GAM) (Havelka, Lazarevic, 1981); 2) The Sport achievement motivation questionnaire (SAM); 3) The Eysenck's personality questionnaire (EPQ).

The results indicated that there are no significant differences in motivation and personality traits between oarsmen of different sport success. The only variables that distinguish oarsmen are positive emotional stability in situation of general achievement (GAM+).

Marinovic (1991). *Fizicka kultura* 44-45: 47-50, 1991

Morgan et al (1988). *Int J Sport Psychol* 19: 247-263

### P10X-09

#### Pre-competition and competition behavior in high performance male gymnasts

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*Keywords: monitoring, gymnastics, Rushall's model*

B. Rushall developed a "detailed, valid model of superior pre-competition and competition practices". This research was meant to determine if Romanian athletes (male gymnasts) fit in Rushall's model for pre-competition and competition behavior.

We worked with 12 peak performance male gymnasts aged  $21\pm2$  ( $x\pm s$ ) ys, members of the Romanian Olympic Gymnastic Team. Pre-competition and Competition Behavior Inventory was applied a few days before a National Gymnastics Championship. Using this inventory, the coach establishes the best training and competition procedures for each athlete to help them perform better. The inventory determines those

behaviors that occur around competitions including aspects concerning psychological preparation, such as: maintaining self confidence, ability to manage stress etc.

The results processed through central tendencies comparison between three outcome groups showed that the peak performance gymnasts generally fit in Rushall's model. Further analyses (cross-tabulation and nonparametrical tests) provided more accurate distributions among their responses. Only 3 cases out of 40 presented differences in mode. We also compared Rushall's model to the group of the Olympic and/or world-champions' results (the top 4 Romanian gymnasts) and their results with the rest of the national team's results. An interested thing is that the top Romanian gymnasts reported nervousness and tension before important competition, while most of the rest of the team didn't (Q5). Being nervous and tense was a symptom of arousal, and when its level is under control, it produces high levels of performance. In Rushall's model, being alone before a competition is preferred, while for the Romanians is not (Q6). However, the top gymnasts were closer to the model; they prefer company only occasionally. While the rest of the team think after the contest that they could have performed better (Q19), and think about their performances long after the competition is over (Q22), the top gymnasts are closer to Rushall's model and think about that only occasionally. What all the Romanian gymnast do sometimes, unlike the groups Rushall studied is that they are upset by "poor calls or biased refereeing" (Q35).

Rushall's researches were conducted among groups of swimmers, divers, basketball and volleyball player, skiers and wrestlers. The inventory proved to be reliable also for the male gymnasts, so we intend to test its reliability in assessing cyclic sports athletes.

#### P10X-10

### Multimedia display of lectures and their information gain in sports

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*Keywords: e-learning, multimedia, web lecture*

The Sport-eL concept of blended learning is based on four levels. Its main object is to prepare the highest level termed "live learning" by means of improving cognition and enhancing know-how. Building and efficiency of electronic on- & offline materials on which the concept is based on, will be displayed in this abstract indicated by Web Lecture production.

A main problem of lectures lies in the limited time available for presentation. Additionally a combination of visual and acoustic information is needed to bear the facts in mind effectively. All verbal information is not reproduceable following the lecture and thus the post-lecture information gain is decreased. With web lectures it is possible to map those lectures live with their synchronised PowerPoint slides. The respective speeches are documented with a software solution called PowerPoint Producer. The respective video stream is captured via fire wire connection between the notebook and a DV-Cam. The publishing process can be done on different quality levels, depending on the future use of the project. E.g., if it is the aim to put the lecture on a website, several different grades of compression can be selected for different internet speeds. Every slide will be transferred into short video sequences, so the respective content cannot be copied out of the presentation. As the in the presentation included videos are not protected in this way, it is recommended to use digital watermarks as copy

protection, especially when the web lecture is published on CD or DVD.

By using feedback forms, the above mentioned documentation of lectures of undergraduate sport students, were evaluated in February 2003 during which the students were allowed to make use of the web lectures to prepare for their examination at the end of the semester. For higher information gain it seems to make sense, that the created layout is appealing but low-key and that the explanation is based on different media.

*M.T.H. Chi, M. Bassok, M.W. Lewis, P. Reimann and R. Glaser (1989). Cognitive Science, 13:145-182*

*Nix, Don. Spiro, Rand J. (1990): Cognition, education, and multimedia: exploring ideas in high technology, J. Hillsdale*

#### P10X-11

### Structural basis for development of computer-based training in sport and sport science

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German Sport University Cologne, Germany

*Keywords: computer-based training, e-learning, hockey*

The use of new media and technology to support structured learning has been growing over the last years. In times of lifelong learning Computer-Based Training (CBT) is a possibility to provide further education. CBT can be seen as a learning program used by learners on a computer. Researches have found a number of possible advantages to traditional self controlled learning.

On the basis of a literature inquiry the study's goal was to research the necessary preconditions of an efficient CBT in sport and sport science and based on the results of the study, to produce a concrete CBT example in the context of the "4-Level Blended Learning" Model.

Evaluation meta-analyses of CBT have shown different results and strong variations in the effectiveness of CBT. In general there have been positive responses by the learners, a reduction of learning time and a slight enhancement of learning success but the application of CBT is no guarantee for learning success. This study chooses to explain the variations in the effectiveness of CBT as a result of the given priority to a development model of CBT. Computer-Based Training depends on exact analyses of requirement, target group, syllabus, resources and the field of application. These analyses affect the didactic and media design of the Computer-Based Training. The decisions made as a consequence of the analyses help to create a storyboard which represents the design and concept of a Computer-Based Training and is an obligatory prerequisite for the realization.

With an accurate conception and realization, CBT is a good option for continuing education in sport and sport science. Generally speaking the technical potentialities of CBT have still got a far way to go. It would be desirable to create systems, which perceive the requirements of the user and present consequential syllabuses.

*Piskurich GM (ed) (2000). The ASTD handbook of training design and delivery*

*Lee WW, Owens DL (2000). Multimedia-Based Instructional Design*

*Kulik JA (1994). Meta-Analytic Studies of Findings on Computer-Based Instruction, In: Baker EL, O'Neil Jr HF(1994). Technology Assessment in Education and Training*

## P10X-12

**Computer assisted scouting and match/game analysis system: The intra-observational reliability of basketball scouting**

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*Keywords: scouting, notation analysis, observer reliability*

An observational system using CASMAS-methodology (Dufour, 93) was used to determine the intra-observational reliability of specific basketball motorbehaviour. By means of two observers, video images, a graphical tablet to enter x,y coordinates of every event on the field, a BBC concept keyboard to enter player number and action (motorbehavior) - based upon 76 identifiable actions earlier subjected to an expert rating - a total of 5 full games of the Belgian competition were analysed.

Table 1: Techno tactical normative profile, Total amount of observations: 7126, Mean amount of observations per game: 1432,5, Detailed Techno-tactical profile of Guard: 29,9 passes - 56,9 dribbles - 39,4 slides, Detailed Techno-tactical profile of Forward: 27,3 passes - 29,3 dribbles - 31,4 slides, Detailed Techno-tactical profile of Pivots: 15,7 passes - 3 dribbles - 13 slides, Table 2: Intra-observer reliability, Intra-observer reliability of, player identification: 97,24 %, motor behavior identification: 86,43 %, spatialisation: test-re-test: no significant differences for both x and y coordinates.

It is possible to notate the history of the ball, inclusive all relevant and sport specific motor behaviour inherent to the game, using an observational system which required 2 observers, on a fair level of intra-reliability.

*Dufour, W., computer-assisted scouting in soccer, Football and Science II, 1993*

*Verlinden M, et al, scoring analysis obtained through observation of football specific motor behaviour, book of abstracts 6th ECSS, 547, 2001*

*Verlinden M, et al, reliability of observational and computer assisted registrational techniques of the human motor behaviour, proceedings of 3rd ECSS, 492, 1998*

## P10X-13

**A statistical method for assessing the reliability of data entered into sports performance analysis systems**

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University of Wales, Cardiff, Wales

*Keywords: performance*

Few research groups have attempted to investigate the most appropriate statistical methods to employ in assessing the stability of data entered into sports performance analysis systems. The statistical method chosen needs to be: i) an index of absolute agreement, i.e. it needs to identify random variation and systematic bias, ii) free from any assumptions about the 'sample' data being normally distributed, iii) independent of high within-systems variance, and, iv) applicable to treating sports performance indicators as individual variables.

By using intra-observer data (test-retest) taken from a hand-notation of where cricket balls alighted having been struck by right-handed batsmen (the performance indicator) in the first 20 overs of the match between England and India at Lords in 2002, the agreement between the test and retest scores can be quantified by simply calculating the differences between the scores when treating the performance indicator as a

separate variable. Because these differences will be discrete and categorical, they will not have a normal distribution. This requires the computation of the proportion of the differences between test and retest scores that are greater than some reference value chosen to equate with "no practically important difference". In this regard we recommend a reference value of  $\pm 1$ . Systematic bias can be confirmed statistically by applying the median sign test, and the confidence interval for the "population" proportion within the reference value can be computed as:  $(A - B)/C$  to  $(A + B)/C$ , where  $A = 2r + z^2$ ,  $B = z \pm (z^2 + 4rq)$ , and  $C = 2(n + z^2)$ . Here,  $r$  is the observed proportion out of a total number ( $n$ ) and  $p$  is the proportion of agreement ( $p = r/n$ ) of the test-retest scores within the reference value  $\pm 1$ . The proportion of the scores that lie outside the reference value ( $q$ ) is given as  $1 - p$ , and  $z$  is the  $100(1 - \text{Alpha}/2)$  percentile from the standard normal distribution.

We conclude that this is a useful, simple and sensitive statistical method for assessing the intra-observer stability of data entered into sports performance analysis systems when performance indicators are treated as individual variables.

## P10X-14

**Game theory application for the 7-m throw in handball**

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*Keywords: handball, game theory*

In order to determine efficiency of the various strategies during the 7-m throw, on the sample of 90 games of the 1st Croatian Handball League in season 1998/99., 622 shots from the 7 meter line were analyzed. In two person game (goalkeeper vs. shooter) following strategies were analyzed: large ( $>3$  m), medium (1.5m -3 m) and small ( $<1.5$  m) step-out as the possible goalkeeper strategies and high, semi-high and low shoot as possible shooter strategies.

According to the results it is obvious that optimal strategy for the goalkeeper is large step-out while the optimal strategy for the shooter is low shot. Also, it can be noticed that small step-out is the worst strategy for the goalkeeper and semi-high shoot is the least desirable strategy for the shooter. Low shoot has the highest efficiency overall because it has the largest body-ball distance. Leg defending movement is slower than the arm defending movement and also, lower extremities are additionally engaged in maintaining pose and body stability as opposite to hands which are free. Semi-high shoot is the most efficient for the goalkeeper because corresponding defensive movement is done on short trajectory by arm and leg as well. This means that the area between the knees and the shoulders is relatively easy to reach for the goalkeeper. The results are indicating that this kind of shoot should be even rarer than at present (16%). Goalkeepers are achieving the highest efficiency by large, then medium and small step-out.

This is the consequence of the ball velocity during the 7 meter shoot which exceeds 100 km/h for the top players that makes it impossible for the goalkeeper to respond in time, so minimization of the undefended area by stepping-out remains the best movement for the goalkeeper.



## P10X-15

**Capacity of attention and the perturbator factors in tennis**

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*Keywords: tennis, perturbation, attention*

Attention is a physical activity, which ensures the active orientation of the body towards the selection of messages, the anticipative adjustment in reception and execution. The bringing up of the attention proposes a great interest for that activity, to develop curiosity, to change the outside motivation into inside motivation, to train the capacity of concentration at perturbator factors.

The sample consisted of 4 table tennis-ballers (seniors) from Sportive Club of the University of Craiova. For determining the concentration of attention, which emphasizes the resistance against perturbator factors too, we used the 4 Pieron's alternative test. For bringing up this quality of attention we used 11 exercises, which were achieved in rapport by perseverance, calm state, efficiency and the difficulty of exercises. For to faith against the perturbator factors we used 7 exercises in a mood elevating practice. We

calculated 3 indicators of resistance, concentration and attention: speed of work, accuracy and efficiency. In connection to these factors were 4 alternative answers: A, B, C, D. The values of speed of work, accuracy and efficiency, for all 4 steps of this test, were converted into 5 marks: VW (very well), W (well), M (medium), S (satisfying), NS (not-satisfying).

The effects of the exercises were estimated through some parameters of the game: the percentage of good services, the efficiency of attacks. The interpretations of the results' spotlight the dynamic aspect of attention's concentration among all table tennis-ballers. The good results established in the final test, the grown percentage of good services, the successes obtained in the last while of the training or match, confirm a good sportive fettle and a special capacity by concentration and resistance of attention in decisive moments of match. Our methods and exercises proposed and used indicate to train the concentration and resistance against perturbator factors in table tennis-baller's training.

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**Poster Session****Biomechanics 1****P10Y**

## P10Y-01

**Effects of muscle structure and function due to growth and development on skating performance in male and female speed skaters**

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*Keywords: growth, maximal anaerobic power, speed skating*

The purpose of this study was to clarify inference of muscle structural and functional characteristics due to growth and development on speed skating performance in male and female skaters.

The subjects were 80 speed skaters, 43 males and 37 females, aged from 10 to 20 or older. These subjects were classified to chronological age groups every 2 years. The mean skating velocity of the individual record produced recently, was used to define the skating performance on 500m. The structural parameter for height, weight, length and girth of the limb and free fat mass (FFM) was measured in all subjects. Muscle thickness of thigh (MT) was measured by B-mode ultrasonic method. Maximal anaerobic power (MAP) was obtained by bicycle ergometer (Power Max V2, Combi, Japan).

Skating performance (SP) developed from 10 to 19 years in both male and female groups. Significant increase of SP occurred from 10 to 15 years in female and from 10 to 17 years in male. Growth patterns of height, weight, and FFM was strongly reflected to SP for both male and female in all age groups. Significant partial correlation coefficients were observed between skating velocity and height, weight, FFM and MT in all male and female skaters. Similarly, muscle function of MAP was related to skating velocities in all subjects. No significant gender difference was observed for MT in all age groups.

From these results, it was suggested that gender difference due to growth and development, especially biological factors might reflect to the skating performance in younger speed skaters.

## P10Y-02

**Impact of flexible lumbar corsets on the functional stability of the lumbar spine during a simulated slip**

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*Keywords: flexible lumbar corset, neuromuscular activity, slip*

Low back pain as well as injuries of the lumbar spine constitutes a common problem of modern society (Denner 1998). It is well known that low back injuries are often a result of sudden unexpected movements such as slips or falls (Cholewicki 2000). To avoid these injuries flexible lumbar corsets have been recommended to stabilize and protect the lumbar region. Therefore the purpose of the study was to evaluate the influence of flexible lumbar corsets on the angular displacement of the lumbar spine and the neuromuscular activity of the trunk muscles during an unexpected simulated slip.

Forty seven subjects (34 male/13 female; age: 42,7 ( $\pm$  7,7)) with no history of spine injury took part in the study. The subjects stood on a treadmill which was moved suddenly and unexpectedly in a forward direction. The treadmill acceleration provoked a hyperextension of the lumbar spine and an involuntary response of the trunk muscles. A three dimensional ultrasonic movement analysis system (Zebris®) was used to determine the angular displacement of the lumbar spine. Surface electromyograms (EMG) were recorded from M. erector spinae, M. rectus abdominis and M.

obliquus externus abdominis. For each trial the EMG was integrated during the first 300ms after acceleration of the treadmill (iEMG 0-300). For statistical analysis paired t-tests on 5% level were calculated.

The maximal hyperextension movement of the lumbar spine was significantly reduced by wearing a flexible lumbar corset. Interestingly, there was almost no change in the iEMG of the M. erector spinae during the first 300ms after acceleration of the treadmill.

The hyperextension movement of the lumbar spine which is a potential cause for injuries in this region was effectively counteracted by wearing a flexible corset. Interestingly this mechanical stabilisation was not accompanied by a reduction in neuromuscular activity of the trunk muscles. On the basis of our results flexible lumbar corsets can be recommended for everyday life with the restriction that almost no consolidated knowledge about the effects of a long-term application is available. Due to this fact further research is necessary to clarify the influence of a long-term application of flexible lumbar corsets on the neuromuscular activity of the trunk muscles.

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#### P10Y-03

### Changes in muscle and joint stiffness properties in ageing

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**Keywords:** aging, stiffness, sinusoidal perturbations

Very few experiments were devoted to possible changes in muscle and joint stiffness, during the ageing process. The aim of this study was to identify changes in stiffness properties of human plantar flexors and ankle joint for over sixty year old.

For the experiment, 12 young (19-24 yr, YG) and 11 old (61-74 yr, OG) men were tested on an ankle ergometer with their left knee extended to 2.09 rad and their ankle placed at 1.57 rad. First, the subjects were asked to develop isometric maximal voluntary contractions (MVC) in plantar flexion. Then, quick-release tests were performed at 20, 40, 60 and 80% of MVC to evaluate musculotendinous (MT) stiffness of plantar flexors. Finally, sinusoidal perturbations were realized at 0, 20, 40 and 60% of MVC to assess musculo-articular (MA) stiffness.

MVC values were found to be significantly lower for OG than for YG ( $P < 0.05$ ), leading to a mean difference of 37%. From quick-release movements and sinusoidal perturbations, stiffness was linearly related to torque, leading to the calculation of a stiffness index (SI) as the slope of this stiffness-torque relationship: SIMT and SIMA, respectively ( $0.752 < r^2 < 0.999$ ). SIMT values were found to be significantly higher for OG than for YG ( $P < 0.05$ ) which corresponded to a mean difference of 35.4%. However, SIMA was similar between OG and YG.

As expected, older men were weaker and exhibited higher MT stiffness confirming the muscular shift towards slow profile with age. These impairments seem to be principally due to muscular atrophy and modifications in both muscle fibre-type distribution and fibre quality. A stiffer muscle-tendon complex induces functional changes as a better transmission in force during stretch-shortening cycle. In old subjects, it can partly compensate the reduction in strength on plantar flexors. Ankle MA stiffness depends on many

factors, including the MT stiffness. Invariance of ankle MA stiffness with age, suggests an adaptive mechanism in articular structures to counterbalance the higher MT stiffness. In ageing, this invariance may avoid new integrations of the ankle stiffness by the central nervous system and may simplify motor behaviour.

#### P10Y-04

### Effect of ageing on twitch contractile properties of the knee extensors in women

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**Keywords:** contractile mechanism, electrical stimulation, aging

The purpose of the study was to examine the age-associated changes in twitch contractile parameters of the knee extensors in women.

The right knee extensors in eight young women (YW; 25.0±4.0 yrs) and eight older women (OW; 67.1±6.6 yrs) were assessed for lean cross-sectional area of m.quadriceps femoris (LQCSA) using magnetic resonance imaging and evoked twitch contractile characteristics using an isokinetic dynamometer linked to an AMLab system. Data was obtained under ISO conditions with the subject sitting upright and the knee positioned at 65° flexion (0°= full extension). A series of maximal voluntary contractions (MVC) were performed and twitch contractile characteristics assessed using a supra-maximal stimulus applied to the femoral nerve. Variables of interest included peak twitch force (Pt), time to peak twitch force (TPt; defined as time from the onset of force production to Pt), half-relaxation time (½RT; defined as the time from TF to half TP), and contraction duration (CD; defined as TPt+½RT).

Significant age-associated reductions were observed for LQCSA (YW 63±8cm<sup>2</sup>; OW 44±5cm<sup>2</sup>), MVC (YW 487±123N; OW 331±58N) and Pt (YW 84±15N; OW 58±19N) ( $p < 0.05$ ). However, no significant difference was observed between groups with respect to Pt/MVC or TPt ( $p > 0.05$ ). ½RT (YW 85.6±15.6ms; OW 109.6±21.6ms) and CD (YW 153.7±22.6ms; OW 187.3±23.9ms), were significantly different between groups ( $p < 0.05$ ).

The major findings of the present investigation were that 1) although LQCSA, MVC and Pt were significantly reduced with age, Pt/MVC remained similar between groups, and that 2) the total contraction duration was significantly prolonged in OW. The results of the present study suggest that much of the age-related reduction in MVC was related to the ageing atrophy, as the reduction in LQCSA and MVC of 30% and 32%, respectively, with age were highly comparable. Furthermore, the comparable Pt/MVC values between groups indicate that knee extensor muscle activation was not compromised in OW. However, ageing was associated with a significant increase in contraction time. Temporal characteristics of the evoked twitch under isometric conditions appear to be dependent upon the kinetics of the excitation-contraction coupling mechanism, including intracellular Ca<sup>2+</sup> transportation. The age-related increase in total twitch contraction duration suggests that the efficiency of the sarcoplasmic reticulum to release and uptake Ca<sup>2+</sup>, and hence the rate of cross-bridge cycling is reduced.

## P10Y-05

**Causes of a negative take-off angle in swimming starts performed by disabled swimmers**

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**Keywords:** *disability swimming, start technique, take-off angle*

The purpose of this investigation was to analyse the start take-off techniques used by disabled swimmers (S7 - S14 functional classes) to identify the causes of negative takeoff angle. The aims of the study were: a) to compare the start, take-off and entry position of swimmers with negative take-off angles to swimmers with positive take-off angles, b) to compare the vertical motion of the body CM and body joints range of motion during push off, c) to compare the position of the body CM at the start of the push-off.

The start was analysed with one video camera filming the swimmer in the sagittal plane; 25 pictures per second were recorded. Sixteen elite disabled swimmers performed two starts. Eighteen points were digitised to define a 14-segment body model. Swimmers were divided into two groups, those with negative take-off angles and those with positive take-off angles. The cause of a negative take-off angle was estimated by comparing the two groups using Kolmogorov-Smirnov two-sample test. An alpha level of less than 0.05 (two-tailed) was considered significant.

The data analysis showed no differences in the initial start position except the horizontal position of CM. In the start position swimmers who used a negative take-off angle stood back more in comparison with swimmers who used a positive take-off angle. Swimmers with negative take-off angles were slower off the block, used greater knee flexion and less range of trunk extension during push off. The vertical position of the CM at the start of ankle plantar flexion and take-off height is lower in negative take-off angle group, during all block time CM of the body is moving down. In comparison, the swimmers with a positive take-off angle continued trunk extension up to the instant of take-off, flexed their knees close to 90 degree, their CM began moving up at the beginning of knee extension and their CM was significantly higher at the instant of takeoff.

The following were identified as the key causes of a negative take-off angle: a) CM too far from the block front edge in the initial start position, b) knees flexing more than 90 degree and an incomplete range of trunk extension during push off, c) CM of the body moving down during knee extension.

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## P10Y-06

**Effect of right arm and shoulder kinematic modification of the take-away in the golf backswing on ball flight distance**

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**Keywords:** *backswing, swingplane*

The aim of this paper is to prove that, regardless of the backswing plane achieved, the kinematics of the right arm and shoulder are acceded to during the backswing in golf, it improves the chances of a more efficient downswing.

Moreover, the movement required to be learnt is easily achieved, and produces immediate results in terms of distance improvement. The subjects for this study were three experienced, right handed golfers, two male and one female. They attended one session each, using their number 6 irons. The same golf balls were used throughout the study. The subjects' swings were recorded both 'before' and 'after' the desired swing change, in sets of 8 balls each time, and from both the frontal and down-the-line views. The best shot of each set, discounting any shot which did not land within the 46m wide fairway, was measured for carry distance. The subjects were required to make only one backswing change - bring the right arm and clubshaft in line with the right heel, without any bend of the elbow or wrist, and then fold the right elbow, in order for the swing to continue to the top. All three golfers not only improved their carry distances, but subjectively noted that the swing change was easy to make, gave a more effortless feeling during the downswing, and higher trajectory. The average improvement in terms of carry distance for the three golfers was 5.5 metres. Thus, it can be concluded that during the backswing, if the right arm and shoulder are moved in an appropriate manner, and placed in a kinematically correct position at the top of the backswing, the hips are able to lead during the downswing, resulting in better distance and a consistently correct downswing plane. This downswing plane is responsible for both trajectory and direction.

## P10Y-07

**Kinetic evaluation of rhythmic hopping movements**

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**Keywords:** *rhythm, hopping, dynamics*

The most natural response to music, is to synchronise our bodily movements with musical rhythm (MR) (Lagre, 2000). The purpose of this study was to kinetically evaluate rhythmic hopping, a movement frequently used during exercise to music.

Four males & 7 females performed 2 sets of 15sec hopping trials on a forceplate (Kistler-9281B11) and Ground Reaction Forces (GRF) were recorded (1500Hz). Three hopping frequencies (HF) were used, preferred frequency (PFH), 98beats/min (LFH) and 155beats/min (HFH). Age, height, and body-mass were  $21.2 \pm 0.5$  yrs,  $176.9 \pm 3.8$  cm,  $78.1 \pm 2.2$  kg for males and  $21.3 \pm 0.5$  yrs,  $166.9 \pm 5.6$  cm,  $63.2 \pm 6.8$  kg for females, respectively. Four of them reported rhythm difficulties. Data from 10 consecutive hoppings (set of trials with the lower horizontal GRF) were used for one way repeated measures ANOVA ( $p < 0.05$ ). Values are mean  $\pm$  SD.

Two females (excluded from group results) were distinctly not synchronised in HF in HFH. For the other 9 subjects, measured HF did not differ significantly from the corresponding HF. Variability was less than 10% for all variables except hopping height (12%-18%). In PFH, measured HF ( $1.62 \pm 0.05$  hops/sec) and maximum vertical GRF ( $2.21 \pm 0.50$  BW) were significantly lower whereas hopping cycle time (tcycle) ( $0.619 \pm 0.006$  sec) and hopping height ( $0.086 \pm 0.024$  m) were significantly higher compared to HFH ( $2.54 \pm 0.07$  hops/sec,  $3.00 \pm 0.36$  BW,  $0.397 \pm 0.006$  sec and  $0.040 \pm 0.012$  m, respectively) with no significant difference from LHF ( $1.85 \pm 0.29$  hops/sec,  $2.78 \pm 0.64$  BW,  $0.555 \pm 0.027$  sec and  $0.092 \pm 0.055$  m, respectively). In HFH, all examined variables differed significantly from LFH and PFH. Relative cycle landing times (53-58%) were greater than relative flight times (42-47%), with no significant differences.

Leg stiffness, for the PFH trials (n=3) representative of the spring-mass model, was higher in HFH (51.9kN/m) compared to PFH (28.8kN/m).

Hopping might be possibly proved as a criterion movement for rhythm evaluation since two subjects were distinctly lacking of synchronization in HFH. Lack of synchronization was not observed in LFH, probably because LFH did not overall differ significantly from PFH. Regarding exercise to music, hopping significantly faster than PFH necessitates the dissipation of significantly higher vertical forces in significantly shorter times.

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#### P10Y-08

### Characterisation of hand's velocity in butterfly stroke according to the breathing technique

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*Keywords: swimming, butterfly stroke*

The purpose of this investigation was to characterise, from a 3D perspective, the hand's velocity in butterfly stroke, and to compare it according to the breathing technique adopted by the swimmers.

7 swimmer performed 3 sets of 3x25 meters with a start in water, at a constant velocity and as close as possible to their maximal speed, using exclusively frontal breathing cycles, lateral breathing cycles and non-breathing cycles in each set. For the 3D analysis of the stroke cycles, it was used the recording and analysis procedures described by Barbosa et al (2002a; 2002b), which included images from 4 non coplanar cameras (including 2 "dual media images"), a VCR at a frequency of 50 Hz and the APAS system. The variables in study were the three components (horizontal, vertical and lateral) of the hand's velocity and the resultant velocity, in each phase of the subaquatic path (entry, downsweep, insweep and upsweep). Differences on the hand's velocity between the breathing techniques were tested using the "ANOVA for repeated measure" technique ( $p < 0.05$ ).

The analysis of the resultant of the velocity of the hands revealed that, in all the breathing techniques, there was a continues increase of the variable during the stroke cycle. The higher value was achieved during the upsweep, as Schleihau et al (1988) reported. The higher values of the horizontal component of the hand's velocity using lateral breathing when compared with the frontal breathing technique might produce an increase of the turbulence and of the wave drag. This probably will decrease the horizontal velocity of the centre of mass and will increase his intracyclic variation. The higher values of the horizontal component of the velocity of the hands using a non-breathing technique instead of the frontal breathing technique during the entry and the downsweep might be due to a great production of Propulsive Drag, instead of Lift Force. In fact, this phenomenon is probably related with the higher horizontal amplitude of displacement of the hand, and the less vertical amplitude observed in the non-breathing cycles. The high standard deviation observed in almost every components and resultant of the velocity of the hands, using the three breathing techniques, might be a result of inter-individual differences in the hands path of the swimmers.

In conclusion, there is no significant modification in the hand's velocity according to the breathing technique adopted in the butterfly stroke.

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#### P10Y-09

### Mechanical and metabolic energy aspects of different binding-boot systems in ski-touring

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*Keywords: ski-touring, mechanical energy, metabolic energy*

Ski-touring has become a very popular sport in alpine areas within the past twenty years. Especially competitive ski-touring has established a new market segment in which minimum weight of material is essential. There is a lack in scientific studies in the area of ski touring. Existing studies predominantly have been pointing out metabolic parameters like heart rate or blood lactate during ascent and descent. Surveys which especially try to analyse ski-touring equipment do not occur in these existing studies.

The purpose of this study was to analyse the effect of different ski-touring equipment on the energy cost of ski-tourers during uphill walking with skis. The material was studied both from a mere mechanical aspect as well as from a metabolic point of view.

For the metabolic study a total of 16 subjects completed several uphill walks with skis on a treadmill inclined 15° and an average walking speed of 2.5 km/h. During these uphill walks the average oxygen uptake was measured by Cosmed K4b2. This part of the study especially concentrated on differences in energy cost during uphill walking with different binding-boot systems. Measurements also included to what extent the parameter walking time affects energy cost during walking with different binding-boot systems. The mechanical study was carried out by measuring mass, points of rotation and center of mass and calculating the mechanical energy cost of the diverse binding-boot systems.

The results of the mechanical study, as well as the metabolic results went into the same direction, though the differences in metabolic energy cost between the diverse binding-boot systems were more distinct. The differences in energy cost among the bindings were significant while the difference regarding boots was not. Taking the results in consideration, the use of specific ski-touring equipment can reduce the energy cost of a ski-tourer which allows him to complete an ascent faster or save energy for the downhill run.

#### P10Y-10

### 3D arthrokinematics of the acromioclavicular joint

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*Keywords: arthrokinematics, manual therapy, acromioclavicular joint*

No specific arthrokinematic study concerning the acromioclavicular joint (AC) has been done so far. Therefore, the aim of this study was to collect quantitative data concerning the arthrokinematic behaviour of the AC joint.

Seven acromioclavicular (AC) specimens were taken from freshly embalmed human cadavers. The scapula was

vertically fixed to a holder in such a way that the clavicle was fully free to move. 3D electromagnetic tracking sensors were fixed on the clavicle and scapula. Subsequently, each clavicle was moved through a selection of directions: pro/retraction, elevation/depression, circumduction and anterior/posterior translation. The positions and rotations of each sensor were collected. The positions and rotations of each sensor were collected. The individual sensor data were used to determine the data of a Cardan approach and the parameters of the finite helical axes for discrete sampling ranges of the motions between the scapula and clavicle: i.e. orientation, position, shift along and rotation about the estimated helical axis. At a later stage, the positions of local anatomical landmarks and joint surface configurations were digitized with a 3D drawing stylus. These anatomical data were used for the definition of local co-ordinate axes to refer to. To analyze the 3D intra articular kinematics of the AC joint, the finite helical axes were considered in terms of a co-ordinate system based on the configuration of the facets of the AC joint and further related to the position of the coracoclavicular ligaments.

The obtained data demonstrated the position of the finite helical axis to shift during each motion from the AC joint to the area of the coracoclavicular ligaments. This relates well with the specific biomechanical characteristics of the acromioclavicular and coracoclavicular ligaments. The data accentuate the gliding characteristics of the acromial facet on the clavicular facet. The clinical impact of the obtained results will be discussed in context of mobilizing and manipulating techniques as used in manual therapy.

#### P10Y-11

##### Effects of pedal rate on cycling kinematics

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**Keywords:** cycling, pedalling rate, kinematic analysis

Electromyographic and kinematic adaptations following changes in workload during cycling are well documented, but those involved by changes in pedal cadence keep unclear. The aim of this study was to examine the effect of cadence change in cycling kinematics of elite endurance cyclists for a constant workload.

Twelve male competitive cyclists ( $20.1 \pm 1.9$  years old; peak =  $72.4 \pm 5.7$ ) were required to perform a submaximal exercise on a cycle ergometer for 15 min at 50% of their  $W_{max}$ . The exercise was divided into 3 equivalent 5 min periods during which subjects were requested to use three different pedal rates in random order (spontaneous cadence, 70 and 90 rev·min<sup>-1</sup>). Pedal rate and kinematic data (instantaneous velocity of the pedal, angle of the ankle) were collected (Kinematics® optoelectronic system): three cameras were used to keep track of reflective markers placed on greater trochanter, lateral epicondyle, medial malleolus, calcaneus, great toe and pedal axis. Cyclists use a mean spontaneous pedal rate of 87.8 rev·min<sup>-1</sup>.

Results demonstrate that pedal rate doesn't influence the variation in pedal velocity throughout a crank cycle. When the data are normalized in percentage of mean pedal velocity, fluctuation keeps constant at  $7.39 \pm 3.45\%$ . Pedalling rate altered the ankle mobility across the crank cycle. Mean plantar flexion observed throughout the crank and ankle mobility increases with pedal rate. The mean angle measured through a complete crank cycle at 70 rev·min<sup>-1</sup> is significantly lower than those measured under 90 rev·min<sup>-1</sup> ( $99.05^\circ \pm 5.3$  vs  $103.61^\circ \pm 6.5$ ;  $F(2,22) = 4.79$ ;  $p=0.01$ ) no

difference exist with free pedal rate (100,68°) condition. Magnitude of ankle mobilisation decreases as pedal rate increases ( $19.73 \pm 7.2^\circ$  at 70 rev·min<sup>-1</sup>,  $17.19 \pm 6.2^\circ$  at free pedal rate and  $16.64 \pm 6.5^\circ$  at 90 rev·min<sup>-1</sup>;  $F(2,22) = 3.62$ ;  $p = 0.04$ ).

The mean angle of the ankle seem to be subdue to the level of force applied on the pedal and the ankle magnitude of mobilisation should be subdue to pedal rate.

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#### P10Y-12

##### In vitro determining of forces in tissues with an optic fibre transducer

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**Keywords:** ligaments, optic fibre, achilles tendon

The optic fibre transducer was introduced to measure qualitatively in vivo forces in tendons (Komi et al. 1996). To evaluate the validity of the optic fibre transducer, it is important to examine the correlation between the optic fibre signal and the isolated tissue (ligament, Achilles tendon) under different load conditions. The purpose of this in vitro study was therefore to examine the reliability of the method as a basis for further in vivo investigations.

The ant. talofibular lig. (ATFL), the ant. cruciate lig. (ACL) and the Achilles tendon (AT) of a right fresh frozen leg from a 80 year old female were fixed with the attached bones in a testing device (Instron-machine). The optic fibre was implanted through the centre of the test tissue with a hollow gauge needle using the standard technique (Komi et al. 1996, Finni et al. 1998, 2000). After that the samples were loaded using different speeds (10, 50, 100 and 500 mm/min) and different loads (50, 100 and 1000 N) by the machine.

In regression analysis we focused the increasing phase during stretching.

The coefficient  $a$  in each tissue ranged from 5.13 to 7.96 mV/N in the ATFL, from 1.90 to 2.87 mV/N in the ACL and was 0.80 mV/N in the Achilles tendon. The coefficient  $r^2$  has a range from 0.957 to 0.987 (ATFL), 0.847 and 0.946 (ACL) and was 0.990 for the AT.

The coefficient of the Achilles tendon experiment was smaller as compared to ACL investigations. The values of ACL trials were smaller than those of the ATFL.

From this experiment it can be concluded that the OFT sensitivity depends on the character (e.g. differences in viscosity) of the measured tissue and from the stretching speed. Further, the structural (e.g. length, cross sectional area) and material properties (differences in molecular bonds between the respective structures) may possibly play an important role in explaining differences between tissues (Anderson et al. 2000).

This in vitro study showed that the optic fibre transducer measured reliable and valid the ligament/Achilles tendon loading.

*Anderson, D.D., et al (2000): Bio and Biol of Movem*

*Finni T et al (1998): Eur. J. Appl. Physiol. 77: 289-291*

*Finni T et al (2000): Eur. J. Appl. Physiol. 83: 416-426*

*Komi P V et al (1996): Eur. J. Appl. Physiol. 72: 278-280*

## P10Y-13

**Speed dependence of gait characteristics in healthy runners and runners with Achilles tendon complaints**

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*Keywords: gait analysis, running, injury*

The causal assignment of biomechanical quantities to the onset of overuse complaints is still subject of debate in gait analysis. One reason might be that gait-analyzing studies on injured subjects are yet to be made. The purpose was to compare biomechanical gait characteristics and their changes with running speed by means of plantar pressure, electromyographic and ground reaction force data in healthy runners and in runners with chronic Achilles tendonitis.

14 healthy runners (CO) and 8 runners with chronic Achilles tendon complaints (ADY) were examined on a treadmill ergometer mounted on force transducers for the sampling of GRFs. EMG was measured on the lower leg and in-shoe pressure distribution was collected. Subjects had to run in random order barefoot (B) and with a shoe (S) at 7km/h and 12km/h. Vertical and a-p forces and impulses were extracted from GRF data, whereas the deviation of the path of the center of pressure (CoP) from the bisection of plantar angle was analyzed from pressure distribution. EMG time and amplitude quantities were determined according to the stride cycle definition by Winter. Descriptive statistical analysis was followed by univariate, one-way ANOVA ( $\alpha=0.05$ ).

Lateral CoP-deviation showed higher values for CO in B compared to S at 12km/h whereas this difference was only apparent in ADY at 7km/h ( $p<0.05$ ). EMG-amplitudes in the extensor loop showed higher activity in CO compared to ADY in the weight acceptance phase at both speeds while statistically significant only at 12km/h. ADY also exhibited higher variability than CO. Force quantities in vertical direction showed no difference between ADY and CO while the breaking impulse was higher in CO compared to ADY and the pushing impulse was higher in ADY compared to CO at 12km/h ( $p>0.05$ ).

Taking the lateral deviation of the CoP as a functional resultant of running mechanics at the foot-ground interface, it can be concluded that patients show different adaptation mechanisms when shoe conditions or running speed are changed. Also neuromuscular control might be changed slightly in injured subjects due to pathology as shown by more variability and lower activity levels of the extensor loop. Force characteristics are similar in both groups which might be an indication that adaptations due to injury are more likely to have neuromuscular reasons than sole mechanical causes. Further studies have to consider that adaptations to injury are dependent on running speed.

Baur et al (2001). *ECSS Book of Abstracts of the 6th Annual Congress, Cologne*, 268

Belli et al (2001). *J Biomech* 34: 105-112

Hintermann et al (1998). *Sports Med* 26: 169-176

Novacheck TF (1998). *Gait Posture* 7: 77-95.

Winter DA (1991). *The biomechanics and motor control of human gait*, Waterloo

## P10Y-14

**Continuous measurement of trajectory and speed to validate a model in alpine skiing with the use of GPS**

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*Keywords: alpine skiing, GPS, kinematics*

At the Institute of Training and Movement Science, a model was developed to calculate the running time and the optimal trajectory in alpine skiing with the use of genetic algorithms. Up to now, results of the validation of the model were promising, but the evaluation (3D-kinematic, DLT) required a lot of time. A GPS-System from the Institute of Outdoor Sports and Ecology offers new possibilities to measure kinematic data of alpine skiers and could be used to validate the model of alpine skiing more speedily. The advantage of this GPS-System is the direct use of the results without time-consuming calculations. Furthermore, data from the GPS-System could be used to produce virtual camera rides and to evaluate the results under aspects of competition and safety (e.g., comparison between real and optimized trajectories, as well as analyses of curve radius, angle of gate entrance, and centrifugal force). The aim of the study was to prove the practical usefulness of this GPS-System in alpine skiing.

Overall, the investigation showed that a DGPS-System allows the recording of kinematic data of a skier with an accuracy range of a few centimetres. Further improvements are necessary to develop a smaller antenna with differential correction, so that it could be placed directly on the ski to reduce measurement errors.

## P10Y-15

**Accuracy and ball velocity of shot in known and unknown visual target in team handball players**

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*Keywords: handball, ball velocity, accuracy*

Success in team handball is determined, among other parameters, by the shot accuracy, as well as the position and the reaction of the goalkeeper. However, in most cases the player who executes the shot must make a final decision about the target taking into consideration both the position as well as the movement of the goalkeeper. The aim of this study therefore was to examine the differences in accuracy and ball velocity between two conditions: a) when the player is aware of the exact target before the shot, and b) when the target is identified with the start of the shot movement.

Three groups took part in the experiments: one group of 15 handball players, the best of League (A1) scorers [age 24.9 (2.9) yrs], another group of 12 handball players, the best of League (A2) scorers [age 26.8 (5.7) yrs] and a random sample of 15 physical education students (ST) [age 21.7 (0.9) yrs]. Accuracy as well as ball velocity were measured by means of specially designed electronic devices (Bayios et al. 1998; 2000). Accuracy (ACC) and ball velocity (BV) was examined in two types of shot: (a) with a cross-over step and (b) with a vertical jump. In the first variation of each shot a red light in the goalpost was lit up and the target was known. In the second, a red light in the goalpost was lit up during movement of the player by using photocells. Photocells were put 1m away from the final step. Five attempts were performed for each type of shot. Accuracy as well as ball

velocity was compared using 2x2x3 analysis of variance (ANOVA).

No significant differences were found between known and unknown visual target at the same type of shot in both accuracy and ball velocity, in the three groups.

The main findings in this study are, that there are no differences in ball velocity and accuracy between known and unknown visual target at the same type of shots in the three groups. The non-significant differences observed in the main dependent parameters among the experimental group, were probably due to the fact that in the unknown target condition the signal was lit up 1 meter away from the final step of the subject. That could be translated to plenty of time in preparing an accurate and fast shot. Therefore, further investigation is needed to explore this possibility.

*Bayios I et al (2001). J Sports Med Phys Fitness 41, 229-35*

*Bayios I et al (1998). Proceedings I: 59-62*

*Bayios I et al (2000). 5th ECSS Annual Congress, Proceedings: 155*

#### P10Y-16

### Estimation of abrasion in running shoes - a comparison of a machine test and a wear test

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*Keywords: abrasion, weartest, running shoes*

To get information about the abrasion behaviour of running shoes generally wear tests are used. But wear tests imply two problems: first the different gait patterns of the subjects result in different abrasion patterns at the same running distance and secondly the test takes about four weeks. To overcome these problems Adidas-Salomon developed an abrasion-simulation-machine that can do an abrasion test within a few hours. The aim of this study was to compare the results of the abrasion-simulation-machine with the results of a wear test.

Two shoe models were included in the study: a "typical" street-running-shoe and a "typical" trail-running-shoe. In the wear test each model was tested by 6 competitive marathon runners over a time period of four weeks. The profile heights of all shoes were measured at the end of each week. In the machine test a material loss was caused by a motion between an abrasive steel disc and the shoes. 2000 operating cycles of the machine were done, the profile heights were measured all 500 cycles.

The results of the wear test show that there are great differences in the abrasion of the shoes of the different runners. For some runners there are even great differences between the left and the right shoe. That means that the abrasion is heavily dependent on the individual man-shoe-surface interaction and therefore hardly comparable. Hence it was only possible to compare the mean values of the abrasion in the wear test with the results in the machine test: 500 machine cycles led to an abrasion that was at an average both greater in the forefoot area and in the heel area than the abrasion in the four week wear test.

The main benefit of the machine test is that it can be reproduced very precisely and can be done within one or two hours. Hence it is possible to get an objective short term comparison of the abrasion of different shoe models. But

such a comparison does not mean to compare a street running shoe with a trail running shoe. In fact it means to compare different models of street running shoes or different models of trail running shoes. In this way, developing a new shoe model the machine test is very useful and much more practicable than a wear test.

#### P10Y-17

### The rehabilitation of patients with hip prosthesis

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*Keywords: hip prosthesis, movement pattern*

The hip joint is the biggest joint of the human body. This joint is the place of many illnesses. The reason of the illnesses is a arthrosis, tumour, pain and inflammation. The preparing and the application of the hip prosthesis has began to progress in the 30th year of last century. In 1946: Judet brothers have prepared a femurhead prosthesis. In 1950: Moore has the cervicocapitalis prosthesis used. The span of hipprosthesis' life is 10-15 year. During this research we have examined the movement-pattern of the subjects. We made comparisons between the subjects, horizontal movement of the foot, the rotation of the body around the vertical axis in the horizontal plane, the flexion and extension, the abduction and adduction of the hip joint.

The purpose was supposed that the gait after hip prosthesis operation has easier, fluentier, plainier and painless, what is very important for the patient. The gait before the hip prosthesis operation is rough and asymmetrical, because the pain which clearly appears in gait, however the subject wanted to dissimulate it. From this reason the purpose is to compare the movement pattern before and after hip prosthesis operation. The subjects (N=25) were active sportsmen and probably, as a result of intensive physical efforts, hip joint abrasion developed. The instable hip joint caused the gait deformation and traumatic gait.

We produced a video recording on the subjects with identical circumstances at the same time. There were recorded two step movement and choosen one of them from each subject for analyses, according to the demands of Ariel system (APAS). The subjects, body builds were different, but their illness, their former active sport carrier, their lifestyles, can be compared with one to another.

The results were demonstrated on the diagrams of the rotation of the trunk in the vertical axis, and in the horizontal plane, of the flexion and extension, abduction and adduction of the hip joint.

It can be said from the results of the investigation that the gait after hip prosthesis operation is easier, strainless and the movement pattern is similar to the healthy, normal gait. The gait before operation is crabbed, asymmetrical and the pattern is deviating from the normal gait. From the analysis of the investigated subjects, gait parameter we can draw the conclusion that the hip prosthesis operation resulted a smoother gait. For those patients, who have problems with the hip joint, an operation can be suggested, because the hip prosthesis is a relief and a real help for them.

## Poster Session

## Biomechanics 2

## P10Z

## P10Z-01

**Specific power capabilities and defining effectiveness of their realization in different environments****Petriaev Alexander, Kleshnev Igor, Sinitsin Anton**

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*Keywords: swimming, strength, immediate feedback*

At present theoretical and practical aspects of strength training in sport are well developed, however a problem of strength realization in a specific sport environment is not yet clear. In our previous researches we showed possibilities to increase the swimmer's capability and stroke strength, but also the possibility to correct the dynamic stroke structure while exercising on the swimming simulator "ART" with the use of the biological immediate feedback method (Petriaev et al., 2002). In real life situations occur where it is difficult to estimate power building effect in the final sport result. A solution to this problem can lie in the use of an additional hydrodynamic body similar to the one used for evaluation of active drag by Kolmogorov (2001).

Eight boys ( $1,64 \pm 0,09$  m;  $50,4 \pm 11,1$  kg;  $X \pm SD$ ) and four girls ( $1,59 \pm 0,07$  m;  $51,3 \pm 7,1$  kg;  $X \pm SD$ ) 13 years old participated in the study. The computer-controlled swimming simulator "ART" was used in the study. The sportsmen performed arm pulling in a test of 10 strokes with the maximum intensity. In the water the athlete swam  $2 \times 15$  m with the maximum intensity with and out the hydrodynamic body (type cone  $130 \times 120 \times 90$  mm) by means of elastic belt. Stroke rate (SR), stroke length (SL) and mean velocity ( $v$ ) of swimming were determined using video analysis.

The data obtained show that there is a difference in result dynamics within the test group. Increase of time difference between swimming with the additional hydrodynamic body and plain swimming shows that there's a well-developed capability to utilize the strength potential at a competing speed. A small difference (below 10 %) testifies that there's a latent opportunity to realize the existing strength potential by improving technical skills. So we suppose that additional hydrodynamic body method can measure the effectiveness of the swimmer's strength potential as it is transferred into a specific swimming capacity. We should note that measurement by this method should be done right after the competition in order to establish the individually optimal correlation of achieved and planned results for the highest velocity for each swimmer and for considering the swimmer's specific strength development.

## P10Z-02

**Surface electromyogram and aerobic power during three stepwise running exercises related to different wear-pressure of sport tight****Nagata Akira, Tajima Taeko, Shima Eiji**

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*Keywords: aerobic power, EMG, sports wear*

This study was designed to develop the new tight wear with generating better performance and anti-fatigue during running exercise, and to compare it with effectiveness of two different pressures of tight wears (H tight:  $10.0 \text{ gf/cm}^2$  and L tight:  $6.2 \text{ gf/cm}^2$ ) manufactured in the sport wear-market. The object of this study was planned to collect data about relationship between the wear-pressure and the bio-signals during prolonged exercise.

Five men volunteered for these experiments that had been practiced at two trials with wearing a different tight for two weeks, separately. The running intensities were set with three stepwise speed increases of 40%, 60%, and 80% of Maximum Speed Records (MSR) of 1500 meters distance. These bio-signals were measured recording the surface electromyogram (EMG) of the Rectus Femoris and the Biceps Femoris at the lower limb and the aerobic power during the whole endurance. Aerobic power was evaluated with oxygen uptake, carbon dioxide output, and ventilation volume from the expired gas analyzer (MMC4400 System) at rest, during exercise and at recovery times. The surface EMG was processed at the power spectrum about Mean Power Frequency (MPF), Logarithmic Slope Spectrum (LSS), and Total Power Spectrum area (TPS) with the computer program of modified Maximum Entropy Method (MEMCalc).

Following items were obtained such as: 1) At the case of L tight, MPF and TPS of the extensive muscles (Rectus Femoris) at the knee were augmented to higher values of average  $47.3 \text{ Hz}$  and  $205.5 \mu\text{V}^2 \cdot \text{Hz}$  (80% MSR), while at the case of H tight, those values showed significant lower levels ( $32.6 \text{ Hz}$  and  $16.8 \mu\text{V}^2 \cdot \text{Hz}$ ). 2) LSS of the Extensor at wears of L tight decreased to the smaller sloping angle (averaged  $0.0052$ ) than that of H tight (averaged  $0.0075$ ). 3) MPF, TPS, and LSS of the Flexor (Biceps Femoris) were at non-significant different values between H and L tights during this running exercise. 4) At the recovery period after the running exercise,  $\text{VO}_2/\text{kg}$ ,  $\text{VCO}_2$ , and VE between the wearing of H and L tights showed lower volumes (L tight) than those of H tight, significantly.

Frequency analysis at surface EMG and results of aerobic power may indicate that the lower pressure of tights for the prolonged exercise have been recruited to superior muscular activities to the higher pressure of tight with much anti-fatiguable motor units and with more endurance contractile type of muscle fibers. Then, motor performance and anti-fatigue of the former should be augmented with the tight.



## P10Z-03

**Influence of the mechanical work and impulse on the energy cost of running****Avogadro Patrick, Chaux Christelle, Bourdin Muriel, Belli Alain**

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*Keywords: graded run, work, impulse*

Up- or downhill running costs respectively more or less energy than level running. Pulling the runner simulates the kinetics of a graded run. Chang and Kram (1999) found a reduced oxygen uptake ( $\text{Vo}_2$ ) with drastic variations of anterior-posterior (AP) impulses (I) when a runner was pulled forward. They estimated that 30% of the total  $\text{Vo}_2$  was due to the generation of AP forces. However, they did not measure the external mechanical work (Wext) which is used by several authors to bridge the gap between metabolism and mechanics during running. The present study was thus conducted to determine the variations in I and Wext and to relate them to the variations of  $\text{Vo}_2$  during treadmill running.

13 healthy trained runners performed 4 bouts of 5 min running at 3.61 m.s<sup>-1</sup> on a treadmill dynamometer : normal (0), pulled by an horizontal rope forward with 5% body weight (Bw) (+5) or 10% Bw (+10) and backward with 5% Bw (-5). Ground reaction forces (GRF) were sampled during the last 20 sec of the bout while  $\text{Vo}_2$  was determined from the expired gas collected during the last 30 sec. Stride time (ST) was determined as the time elapsed between a foot strike to the next ipsilateral foot strike. Vertical (Ivert), braking (Ibrake) and pushing (Ipush) I were computed as the time-integral of respectively the vertical, negative AP and positive AP GRF. Wext was computed during the braking (Wext-) and pushing (Wext+) phases following Cavagna (1975). Correlations were determined between the variations of  $\text{Vo}_2$  and the variations of Ivert, Ibrake, Ipush, Wext-, Wext+ in graded relative to the 0 conditions. Statistics were conducted using a Pearson's correlation test, a one-way ANOVA for repeated measurements and Scheffe's post-hoc test.

AP I, Wext+, Wext- and  $\text{Vo}_2$  were significantly affected by the pulling ( $p < 0.001$ ). Stride frequency was significantly higher in the +10 vs -5 conditions ( $p < 0.05$ ). The variations of  $\text{Vo}_2$  were significantly correlated to the variations of Ibrake, Ipush, Wext- and Wext+ (all  $p < 0.001$ ) but not to the variations of Ivert ( $p = 0.20$ ).

The important variations found for AP impulses (-66 to +95%) were similar to the result of Chang and Kram (1999) while the relatively small variations of Wext- and Wext+ (-11 to +11%) were comparable to the expected changes induced by the pulling force. The relative variations of  $\text{Vo}_2$  (-25 to +32%), between the amplitudes of variation of both I and Wext, suggest a combined effect of these two mechanical factors on the metabolic demand.

## P10Z-04

**Early structural manifestations of myofibre injury in skeletal muscle after controlled lengthening contractions****Komulainen Jyrki, Hesselink Matthijs, Drost Maarten, Heikkilä Maarit**

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*Keywords: muscle injury, cytoskeleton, dystrophin*

Unaccustomed exercise may induce damage in certain skeletal muscles. The early phase, that contains sarcolemmal damage, disruptions in contractile components

and cytoskeletal changes, leads to degeneration and necrosis of the affected fibres in the secondary phase. However, simultaneously with degeneration repair processes were involved and the myofibres may be mended instead of death. It is obvious that the damaging effect is rather a consequence of the mechanical stress than the number of contractions. The mechanical stress during lengthening contractions is mainly concentrated on the intermediate filament system, dystrophin, and specialised plasma membrane complexes. The aim of study was to evaluate the early phase of changes in proteins of the contractile system and sarcolemma after controlled lengthening (CL) contractions in skeletal muscle.

Tibialis anterior muscles of anaesthetised rats were subjected to 240 CL. The contra lateral leg was used as a control. Muscle samples were taken 0 h and 4 d post-exercise. Muscle beta-glucuronidase activity, beta-GU, a biochemical indicator of muscle damage was determined. Antibodies were used for double stainings: actin and dystrophin (rod domain), dystrophin (C-terminus) and beta-dystroglycan, desmin and dystrophin (rod domain), dystrophin (C-terminus) and dystrophin (rod domain), and were analysed with confocal microscopy.

The significant increase in beta-GU activity was detected 4 d. At 0 h few fairly rounded swollen fibres indicated the damage. At 4 d necrotic fibres, inflammatory response and the first signs of repair processes were noticed. Immediately after CL beta-dystroglycan staining was still intact while total or partial actin and desmin staining were detected in some swollen fibres. However, some actin staining was seen in clusters next to sarcolemma in a few fibres. In some myofibres only subsarcolemmal desmin was observed. In some swollen fibres staining in dystrophin C-terminus was discontinuous or totally missing while staining of the rod domain was still intact. In some of the swollen fibres the disappearance of both dystrophin stainings was detected.

The results of this study show that hardly observed minor myofibre injury immediately after CL will develop into a massive damage within four days post exercise. The observations indicate the segmental sensitiveness of dystrophin molecule in physical stress and disturbed structural integrity in all studied proteins during the early phase after CL.

## P10Z-05

**Changes in muscle architecture during prolonged strength training in previously untrained older women and strength trained young men****Ahtiainen Juha, Selänne Harri, Kraemer William, Häkkinen Keijo**

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*Keywords: strength training, muscle architecture, isometric force*

It is well known that muscle CSA increases during prolonged strength training. According to the study of Aagaard et al. (2001), beside with the increase in muscle CSA muscle pennation angle can also increase during strength training. The present study included two drastically different groups with regard to muscle mass and strength. Young strength trained men had large muscle mass and high absolute strength, while older untrained women had already gone through age-related decreases in muscle mass and strength. The purpose of the present study was to compare changes in muscle architecture of the vastus lateralis during the 21-week

strength training in untrained older women and strength trained young men.

Subjects: six strength trained young men (YM) ( $29.8 \pm 6.0$  years) and 13 untrained older women (OW) ( $65.6 \pm 3.8$  years). The experimental design: 21 weeks of heavy resistance strength training. Muscle strength and architectural characteristics were measured before, in the middle and after the training period. Measurements: maximal isometric bilateral leg extension force was measured by the dynamometer. The thickness of the m.vastus lateralis (MTH) and pennation angle of the fascicles (PAN) was measured by B-mode ultrasound from the lower third portion of the right thigh.

Isometric force increased by  $6.9 \pm 12.5\%$  (ns.) and  $13.9 \pm 10.8\%$  ( $p < .001$ ) during the training period in YM and OW, respectively. In YM the 21-week training period led to increases in MTH by  $8.9 \pm 5.3\%$  ( $p < .05$ ) and PAN by  $0.2 \pm 13.3\%$  (ns.). In older women MTH increased by  $8.4 \pm 9.3\%$  ( $p < .01$ ) and PAN by  $17.5 \pm 8.8\%$  ( $p < .001$ ). The changes in MTH and PAN tended to correlate with each other ( $r = .48$ ,  $p = .1$ ) in OW. The changes in maximal isometric force and PAN correlated with each other ( $r = .61$ ,  $p < .05$ ) in OW. The present study showed that not only MTH but also PAN were greater in strength trained young men than in previously untrained older women. YM showed only some increase in MTH during the experimental strength training period, but no significant changes were observable in PAN. OW showed significant increases in both muscle thickness and pennation angle throughout the 21-week experimental strength training period.

The data indicate that the plasticity of the muscles even in older women can be maintained so that muscle architectural characteristics are changeable due to adaptation processes caused by strength training.

Aagaard P et al (2001). *J Physiol* 534: 613-23

#### P10Z-06

### Relations between explosive strength, stiffness and sprinting performance of Slovenian sprinters

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Keywords: *sprint, stiffness, explosive strength*

The aim of the present study was to identify the relations between maximal running velocity and acceleration, as an indicator of performance on the one side, and squat jump and drop jump, as an indicator of explosive strength and stiffness (Bosco, 1999) on the other side.

The acceleration and maximal running velocity developed by 33 Slovenian sprinters ( $23.9 \text{ yr} \pm 3.88 \text{ yr}$ ,  $181.01 \text{ cm} \pm 5.72 \text{ cm}$ ,  $78.9 \text{ kg} \pm 6.2 \text{ kg}$ ) during 60-m sprint were measured with BROWER Timing System on indoor athletic track. Each subject ran 60 m with maximal acceleration from crouch start. The maximum running velocity ( $v_{\max}$ ) was measured in the 20 meters segment between 30 and 50 m. The acceleration velocities were measured in the 10 meter segment between start and the 10th m ( $v_{\text{accel.1}}$ ), in the segment between the 10 th-m and the 20 th-m ( $v_{\text{accel.2}}$ ) and in the segment between 20 th-m and 30 th-m ( $v_{\text{accel.3}}$ ). Squat jump parameters and drop jump from 25cm box were measured with tensiometric platform (Kistler, 9278, Winterthur, Switzerland) in laboratory environment.

SJheight correlate with  $v_{\text{accel.1}}$  ( $P < 0.01$ ),  $v_{\text{accel.2}}$  ( $P < 0.05$ ),  $v_{\text{accel.3}}$  ( $P < 0.01$ ),  $v_{\max}$  ( $P < 0.01$ ). SJtake off velocity correlate with  $v_{\text{accel.1}}$  ( $P < 0.01$ ),  $v_{\text{accel.2}}$  ( $P < 0.05$ ),  $v_{\text{accel.3}}$  ( $P < 0.01$ ),  $v_{\max}$  ( $P < 0.01$ ). DJheight correlate with  $v_{\text{accel.2}}$

( $P < 0.01$ ),  $v_{\max}$  ( $P < 0.01$ ). DJtake off velocity  $v_{\text{accel.2}}$  ( $P < 0.01$ ),  $v_{\max}$  ( $P < 0.01$ ).

Squat jump parameters significantly correlate with maximal running velocity, as well as with all three segments of acceleration phase. Concentric muscle action characterised squat jump performance (Bosco, 1999). In the phase of initial acceleration, when the sprinter still run with a pronounced forward body lean, much of the force comes from muscle concentric action rather than elastic response (Delecluse, 1997). On the other hand, drop jump parameters significantly correlate especially with maximal running velocity during 60-m run. Muscle stiffness, which represents the neuromuscular capacity to develop high levels of force during the stretch-shortening cycle, determines sprint performance, while running at maximum speed. We could conclude that although explosive muscle strength is needed for initial acceleration and maintaining a maximal velocity in sprinting, high leg stiffness is needed especially for maximal running speeds.

Bosco C (1999). *Strength assesment with the Bosco's test*. Delecluse (1997). *Sports Med*. 24(3): 147-156.

#### P10Z-07

### Reaction force of swinging on rings during performing exercises of different level of difficulty

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Keywords: *gymnastics, force analysis, swing*

Swing is a basic technical element of all gymnastic exercises on apparatus. Mobility of rings in space may cause forces in the bottom position that exceed the reaction capability of the motor system bonds. Intuitive association of difficulty of swing with the accompanying force may be far from reality. Similar reasoning concerns the relation between the performance level and force. The purpose of this paper is to analyze the values of reaction forces that arise in swing exercises characterized by different level of difficulty.

Twelve gymnasts aged of first, second, and master sport's class (7-20 years of practice) performed a series of ring exercises with different levels of difficulty: A - salto stretched from inverted hang, B - uprise backward to straddled L-sit from handstand, C - giant swing to handstand. Description of the swing dynamics is based on: maximal force, duration time, value of force impulse, relative force and duration of semi-period of a pendulum-like cycle.

Taking the time characteristics of exercises performed on rings one may conclude that group A differs from groups B and C, especially in TC and TA. As the force characteristics is taken into account, the exercises of group C differ significantly from group A and B, and only relative force (RF) is different between A and B.

The above characteristic of swings on rings divided into three groups of difficulty allows us accept a rule, which agrees with intuitive understanding, that the centrifugal force increases with the rising range of swings (the rising difficulty of exercises) causing the increase in the overloading that acts on the gymnasts. The abruptness of changes of the overloading depends on the execution time of the swings, which may significantly vary due to specific motor program.

The main factor that causes overloading of gymnasts' motor system during execution of swinging movements is the force impulse effectuated by interaction between gymnast and cables. This impulse may be dangerous for the athlete if his central nervous system has insufficient information concerning the shape of the impulse. The shape contains precise information on the amplitude and velocity rate of the

external force. This situation is often encountered while learning new and difficult exercise programs. Another hazard for the motor system is a large number of repetitions of such force impulses absorbed by gymnasts during training.

#### P10Z-08

### Relationship between overarm throwing movement velocities on partial joint and throwing performance in baseball players

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*Keywords: baseball, overarm throwing*

The effects of physiological and biomechanical factors on throwing performances in well-trained baseball players were studied in many researches. There are few reports about the relationship between throwing velocities of the partial joints and throwing performance in baseball players. The purpose of this study was to clarify the relationship between pitched ball velocity as throwing performance and overarm throwing movement velocities on partial joints in well-trained baseball players.

Eighty-four varsity male students, 46 well-trained baseball players (BP) and 38 students of physical education as a control group (CON), without throwing arm problems voluntarily participated in this study. Maximal overarm pitch ball velocity for throwing performance was obtained by a Radar gun (Mizuno, Japan). Each subject performed a warm-up routine including stretching and throwing drills, then threw five fastballs distances of 5m for data collection. Maximal overarm throwing movement velocity measurement on partial joints for whole body, trunk, shoulder, elbow and wrist were observed by custom-made movement velocity measurement system in connection with Speed Meter (Vine co., Japan).

Maximal pitched ball velocity in BP was significantly faster than that of CON ( $p < 0.05$ ). Significantly higher values of overarm throwing movement velocities on partial joints in BP were observed for whole, trunk and wrist ( $p < 0.05$ ). Significant correlation coefficients between maximal pitched ball velocity and throwing movement velocities on partial joints for whole ( $r = 0.573$ ,  $p < 0.05$ ), trunk ( $r = 0.339$ ,  $p < 0.05$ ) and wrist ( $r = 0.403$ ,  $p < 0.05$ ) in all subjects were observed. Maximal overarm pitched ball velocity in BP was closely related to the throwing movement velocity on whole joint ( $r = 0.610$ ,  $p < 0.05$ ). No significant correlation coefficients were observed between maximal pitched ball velocity and overarm throwing movement velocities on partial joints in CON.

In this study, the effect of overarm throwing movement velocities of partial joints on throwing performance were clarified in baseball players and control subjects. The maximal overarm pitch ball velocity in well-trained baseball players was significantly higher than that of control subjects. Maximal overarm pitch ball velocity was closely related to the maximal overarm throwing movement velocities on partial joints in well-trained baseball players. From these results, it seemed that velocities on partial joint movement reflect to the throwing performance in baseball players.

#### P10Z-09

### A simple approach to evaluate the 100m sprint race

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*Keywords: coaching, sprint*

For the individualization of training programs the coach should be able to characterize the event and the athlete, to possess the necessary information to make proper decisions in all aspects of coaching program. The velocity curve of 100m run reveals the change of velocity during the entire distance, allowing the division of the event in different phases (start, first acceleration, second acceleration, maximal velocity, deceleration, finish). Nowadays it's simple to evaluate the velocity of a sprinter with some accuracy. In competition the coach can easily have access to times and distances, using normal images (obtained from video or TV) and some marks found on athletic tracks (50m and 60m starts, and the 100m 110m and 400m hurdles marks). But how can the coach use the values from those evaluations?

The coach can utilize the important data obtained from 100 m elite competitions (split times) to understand the ability of his sprinters. We make use from the data available from different studies (Muravec et al. 1988; Brüggemann & Glad, 1990; Ae et al. 1992; Wolfgang, 1997; Turk-Noack, 1998; Sánchez et al. 2000) obtained in 100 m elite competition ( $10''.39 \pm 0''.49$ , from  $9''.79$  to  $11''.29$ ).

Applying simple linear regression equations to these data (10m split time intervals) we should help, the coaches to analyze the results from the evaluation of athletes with more effectiveness. Based on this analysis the coach can identify the possible strengths and weakness of the athlete, choosing the phase(s) that need training focus and select the methods and means for the training process with more accuracy.

Ae, et al. (1992). *The men's 100 meters. New Studies in Athletics*, 7(1), 47-52.

Bruggemann, P. & Glad, B. (1990). *IAAF Scientific Research Project at the Games of XXIVth Olympiad-Seoul- 1988: Final Report*

Sánchez, et al. A. (2000). *Biomechanical analysis: Throwing and running events The IAAF WC in Athletics 1999*

Moravec, et al. (1988) *Scientific Research Project on the II World Championships in Athletics - Rome 1987.*

Turk-Noack, U. (1998) *LAVER Analysis of 100m sprint events (Olympic Games, Atlanta 1996) (unpublished lecture notes)*

Wolfgang, R. (1997). *100 meters (results biomechanical research project at the VIth World Championships in Athletics, Athens 1997). New Studies in Athletics*, 12(2-3), 45-48.

#### P10Z-10

### The relationship between functional buoyancy, torque and body angle among age group and senior swimmers

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*Keywords: swimming, underwater torque, buoyancy*

The aim of this study was to examine the relationships between buoyancy (B), floating torque (T) measured in a static position and body angle ( $\alpha$ ) (the result of active torque).

Ten children (C, age 11.7 years) and 13 adults (A, age 21.7) volunteered for this study. The mass (M) and inspiratory

buoyancy (B) were measured by weighing the subjects on land and under water respectively, centre of mass (CM) and centre of volume (CV) were measured by placing subjects at different positions on a balance board on land and under water respectively. The angle between the water line and the head-hip line of body ( $\alpha$ ) was measured by underwater videography.

High correlations were found between T and B for A, C and all subjects ( $r=0.95$ ,  $r=0.91$  and  $r=0.89$  respectively). The A group had significantly higher T (0.55Nm) and lower  $\alpha$ ; ( $10.8^\circ$ ) than C (0.22Nm and  $16.8^\circ$  respectively). No significant correlations were found between T and  $\alpha$ ; and between B and  $\alpha$ .

While theoretically, buoyancy and torque seems unrelated, there was a high positive correlation for all groups - those with greater buoyancy have also greater underwater torque. The senior swimmers had significantly higher passive underwater torque than the youth swimmers, due to relatively longer and/or heavier legs or greater relative lung volume. The poor correlation however, between passive underwater torque and body angle (indirect measure of active torque) supports the argument that the latter is more relevant for swimming. The young swimmers had a significantly greater active body angle than the seniors. This could be explained by better technique among the seniors if we accept the argument that skillful propulsive movements produce a favorable torque for swimming. There was no significant difference in buoyancy between the two groups and buoyancy correlated poorly with body angle, suggesting that buoyancy plays a lesser role in swimming, and strengthens the argument that passive torque and active torque are weakly related and that passive torque is only weakly related to propulsive efficiency.

#### P10Z-11

### Relationship between long jump performance, isokinetic leg strength and power tests in young jumpers

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*Keywords: athletics, isokinetic strength, long jump*

In an attempt to reveal the influence of the condition level of young athletes upon their competitive performance, the purpose of this study was to examine a) the relationship between long jump performance (LJP) and isokinetic moment of force of knee extensors and ankle plantar flexors and b) the relationship between LJP and selected power tests of ballistic type in young male jumpers.

Twenty-one male jumpers (age  $15.6 \pm 1.2$  yrs; body mass  $67.6 \pm 6.5$  Kg; height  $176.9 \pm 4.7$  cm) volunteered to participate in this study. The subjects performed a long jump under competitive conditions (the greater effective distance of three well trials was received as the performance). They also performed four sorts of vertical jumps (a squat jump, a counter movement jump, a drop jump of a level of 40 cm and a drop jump of 80 cm) as control tests for the vertical component of the take-off phase in long jump, and a 30 m flying start sprint running as a control test for the horizontal component of the same phase. An Ergojump device for estimating the peak height of the vertical jump tests and an electronic photocell system to monitor the sprint time score were used. Isokinetic measurements (Cybex Norm Dynamometer) were used to estimate the leg strength. In order to examine the isokinetic moment of force of the knee extensors and ankle plantar flexors the subjects performed

three sub-maximal and three maximal efforts of each muscle group at concentric and eccentric angular velocities of 60, 300 o/s and 60, 120 o/s for the knee and the ankle joint, respectively.

Pearson's product correlation tests revealed that there was a high positive relationship ( $a = 0.01$ ) between long jump performance and the height score of the selective vertical jumps, and a highly negative one ( $a = 0.01$ ) between long jumping performance and the 30 m sprint time score. There wasn't any significant relationship between long jump performance and isokinetic moment of knee extensors and ankle plantar flexors, except the moderate one ( $a = 0.05$ ) of the isokinetic moment of the knee extensors at a concentric contraction of 300 o/s. The above results indicate that the most informative tests as predictors for the dependent variable (long jumping performance) are the drop jump from a level of 40 cm ( $r=0.82$ ) and the 30m sprint running ( $r=-0.82$ ).

#### P10Z-12

### An optoelectronic analysis of backward flic-flac in male and female gymnasts

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*Keywords: gymnastics, optoelectronic analysis, technical measurements*

In gymnastics, performance largely depends on a correct body shape. In the present study, a technical analysis of the backward flic-flac was performed by using an optoelectronic system.

Six men and three women (age: men  $20 \pm 2$  yr; women  $19 \pm 1$  yr) experienced gymnasts volunteered. The body weight ( $69 \pm 6$  kg;  $59 \pm 14$  kg), the stature ( $168 \pm 7$  cm;  $163 \pm 13$  cm) of each athlete were measured; the Body Mass Indices (BMI) were calculated ( $24 \pm 3$  kg/m<sup>2</sup>;  $22 \pm 2$  kg/m<sup>2</sup>). The body composition was estimated by bioelectric impedance analysis. The %Fat Free Mass (FFM) of each gymnast was considered ( $84 \pm 4\%$ ;  $80 \pm 2\%$ ).

Thirteen spherical retro-reflective markers were positioned on the body of each athlete: right and left lateral malleolus, fibular head, greater trochanter, acromion, olecranon, styloid process of the ulna; vertex.

Each participant performed three series of five repetitions of the flic-flac (1-min stop between each flic-flac; 5-min between each series). Each flic-flac was executed starting from the standing position. The movements were filmed by an 8-TVC optoelectronic system, and the digital metric coordinates of each marker were obtained.

The distance of flight (start position-end of the first flight), angle of escape (ground-acromion-fibular head line in the frame of passage between knee flexion and extension), and trunk-thigh angle (acromion-greater trochanter-fibular head just before the beginning of the first flight) were calculated. Correlation coefficients were also computed.

Men had a significantly longer distance of flight than women ( $1009 \pm 126$  mm;  $713 \pm 84$  mm). No sex differences in the escape and trunk-thigh angles were found. The distance of flight was excellently related to the escape angle, and approx 88% of the distance was explained by this angle. Standing height influenced the trunk-thigh angle. Body weight was fairly negatively related to the escape angle. Better relationships were found between BMI and the escape angle, and the %FFM and the trunk-thigh angle.

Technical measurements are qualitatively approximated by visual observation of coaches and referees. In the current

study, three of the most used measurements were obtained from 3D reconstructions of a repeated backward flic-flac. The effect of individual characteristics on the technical measurements was also assessed.

*Eckerson JM et al (1997). Med. Sci. Sports Exerc. 29: 962-968*

*Sforza C et al (2002). Percept. Mot. Skills 95: 433-444*

#### P10Z-13

### Impaired postural control of women with low back pain under various dynamic conditions

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Bu Ali Sina University, Iran

**Keywords:** low back pain, dynamic balance, center of gravity

Many studies have been conducted on the static balance evaluation of different disease such as low back pain. However, there is a little information on the dynamic balance impairments. The objective of this study was to compare the oscillations of the center of gravity (COG) of LBP patients with the healthy subjects under various dynamic conditions.

Thirty low back pain patients and 30 healthy females between 20 to 40 years of age voluntarily participated in this experiment. A dynamic stability platform system (BIODEX) was used to evaluate the anterior-posterior direction (AP) and medio-lateral (ML) directions and overall (total) COG sway during upright standing and standing with 45° trunk flexion postures. These tests were repeated with and without shoes as well as on stable and instable foot platform conditions. Multivariate analysis of variance was used for statistical analysis.

Results showed that in all the evaluations the COG sway was greater in LBP patients. In stable foot platform the patients' body sway was affected more in AP direction than in ML. Instability of the foot platform resulted in more abnormalities of the COG sway among patients ( $p=0.01$ ). Flexed posture decreased the body sway in both groups. Shoes did not have any influence on dynamic postural sway. There was a significant interaction between stability of foot platform, posture and LBP factors.

In conclusion, the COG sway in LBP patients was significantly deviated from normal pattern. Voluntary motor control deficits were more obvious when standing on an instable base of support. There was an interaction between instability of base of support, posture and back pain factors.

#### P10Z-14

### Comparative study on able-bodied and disabled freestyle swimmer

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**Keywords:** swimming of disabled, movement analysis, PSQ

In elite swimming the movement analysis is very important to judge the movement coordination of athletes. This approach allowed statements about the current movement behaviour and the level of movement coordination. Due to the variety of functional influences regarding to the impairments of disabled swimmers we can not transmit without further ado the results of able-bodied athletes.

One disabled swimmer (athlete 1-A1) and one able-bodied swimmer (athlete 2-A2) were examined and performed a "step test" in freestyle in a swimming flume with constant

velocity. The flume velocity corresponded with the currently existing competition results and can be taken as optimal velocity of each swimmer. For 2-D video recording a camera was outstanding installed. Using the software SIMI Motion® the data evaluation of marked body points was carried out. The swim movement was characterized using the model of swimming phases by JÄHNIG et al. (1973).

For the results of both athletes we used the step  $\pm 0N$  where swim movement isn't influenced by the flume (SCHEGA et al., 1997). The horizontal velocity of the hip of A1 was compared to A2. Differences were also determined by the examination of the cycle frequency. To characterize the movement efficiency in dependence on the increasing load we used the "Phase Structure Quotient (PSQ)" by BLASER et al. (1995), as quotient of the main phase and the sum of initiating, linking and preparing phase. The average PSQ for A1 was significant higher than for A2 (FRIEDMANN-test).

The described values of the swim movement are more favourable of A2 compared to A1. The PSQ prove this fact because the smaller the better effective is the swim movement. A possible different structure of propulsion caused by the functional impairment of A1 influences the swim movement.

*Blaser P, Stucke C & Witte K (1995). Leistungssport (1) 25, 36-39. Jähmig GW, Wunsch D & Wiegand K (1973). Dissertation, Universität Halle-Wittenberg. Schega L, Stucke C & Witte K (1997). Leipziger Sportwissenschaftliche Beiträge 1, 55-71.*

#### P10Z-15

### Considerations about the fractures of the metacarpi bones

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**Keywords:** metacarpi bone, finite element method, fracture

The metacarpi bones are the longest and the least mobile but at the same time the most solicited bones of the hand. This is why the frequency of fractures at these bones is very high.

The study material was represented by 247 fracture cases of the hand bones, studied at the Dolj County Hospital, during a period of 5 years.

The authors used the finite element method for the spatial model of the metacarpi bone. The geometry's and mechanical properties' natural variability of the bone system from one to the other is a big problem, which makes real difficulties in the biomechanical researches. It must be watched so the idealized structure should be the best solution to many requests concerning the number of the junctions and of the elements, the types of elements, the number and type of the loading forces. The authors used the section method of the bone divided into 23 sections parts with the tomograph computer. We determined precisely the spatial coordinates of a 12 points set from every section's boundary. Then we built the spatial model of the metacarpi bone using the finite element EMRCNISA soft. At first, with the lines' method the points have been united by interpolation, giving the every section's form. Then, with the help of the surfaces' method, there have been united close sections two by two and with the hyper surfaces' method, the programme realized the spatial modelation of the whole bone. The modelation was realized with hexahedral finite elements. During this study, we made a statistical analysis of the fracture cases, analysis on age and sex.

## P10Z-16

**Electromyographical study of the pectoralis major (sternal portion) and deltoid muscles (medial portion) in volleyball sequential actions****Bankoff Antonia, Rocha Dario, Zago Leandro**

Faculty of Physical Education, University of Campinas, Brazil

*Keywords: EMG, m. pectoralis major, m. deltoides*

Considering that by the anatomic shape (bipennate) of the deltoid muscle (medial portion) and for the fiber dispositions in a diagonal form, they conduct a contraction even more intense and less extensive than the others portions, performing their higher activity between 90 and 180 degrees of abduction, while the pectoralis major muscles (sternal portion), is primarily a motor in the arm abduction movement, realizing in this way antagonistic effort (Hamill and Knutzen 1999).

The pectoralis major muscles (sternal portion) and deltoid (medial portion) had been studied using electromyography in 8 male individuals, who practice volleyball, youth category, (age between 15 and 17 average  $\pm$  16,25 years old), right-handed. Those involved in volleyball for about one year. The objective was to analyze the potential of action of these muscles engaged in the volleyball movements: service, spike, pass, set and blocking with and without ball. The work was developed in the laboratory of Electromyography and Biomechanics of Posture (Physical Education Faculty-State University of Campinas - Unicamp). To capture the muscles action potential, surface electrodes were set with conductive gel and fixed on the skin, in the center of the portion muscles. An electromyograph Lynx with 6 channels was used. The apparatus calibration was 3000  $\mu$ V, 1199.760 Hz. The sequential experiments without ball were performed for 10 seconds, and the sequential experiments with ball in 12 seconds.

The pectoral muscle (sternal portion) revealed activity in all movements of the extension of the arm, in the basic movements of volleyball, (service and spike), as well as the arm abduction during the pass movement. The deltoid muscle (medial portion), in spite of being motor primary in the abduction, showed the potential of action in all movements practiced in volleyball, however, they are more intense, in the spike and block actions. It is interesting to observe, that the general average and the standard deviation of the deltoid muscle (medial portion), was higher in the sequential movements executed without ball.

*Hamill J, Knutzen MK (1999). Bases Biomecânicas do Movimento Humano*

## P10Z-17

**Electromyographic study of hamstrings muscles in cycling, roman table and locomotion activities****Moraes Antonio, Bankoff Antonia, Rocha Dario**

Faculty of Physical Education, University of Campinas, Brazil

*Keywords: EMG, cycling, hamstrings*

In the last years electromyography has been increased within the development of sport science, contributing significantly to the muscle biomechanics of the hamstrings (biceps femoris - long head, semitendinosus and semimembranosus). They have been the target of many investigations, because they are two-joint muscles. Since all the hamstrings cross the knee joint, producing as much flexion as the rotation of the leg, its effectiveness as extensors of the hip depends on the positioning of the knee joint (Hamill and Knutzen, 1999). The two-joint muscles, biceps femoris (long head), semitendinosus and semimembranosus act in joint movements of the hip (extensors) and in joint movements of the knee (flexors).

These muscles had been studied through the electromyography in 18 male individuals (age between 19 and 25 average  $\pm$ 22.8 years old), with the purpose to verify the potential of action and its participation in the following activities: treadmill locomotion, cycling and Roman table. The work was developed in the laboratory of Electromyography and Biomechanics of Posture (Physical Education Faculty - State University of Campinas - UNICAMP). To capture the muscle action potential, surface electrodes were set with conductive gel and fixed on the skin, in the center of the hamstrings muscles. An electromyograph Lynx with 6 channels was used. The apparatus calibration was 3000 $\mu$ V, frequency of 1199.760Hz.

The presented results demonstrate: a) the smallest general averages and standard deviation were observed in cycling activity as well as in all studied muscles; b) the semimembranosus muscle demonstrated the highest values in RMS (root mean square), in all studied activities, followed by the semitendinosus, and later, by the biceps femoris (long head). The highest potential of action was registered in Roman Table in the semitendinosus and semimembranosus muscles and in treadmill locomotion in the biceps femoris.

## Symposium

## Gene Expression: Training and Diet Interaction

S103A

## S103A-1

**Exercise and dietary effects on gene activation related to vascular function: A study on exercising pigs****Booth Frank**

University of Missouri, United States

*Keywords: gene expression, physical inactivity, heart disease*

Physical inactivity (PIA) increases the risk of coronary heart disease (CHD) and produces measurable decrements in maximal cardiorespiratory oxygen transport. A PIA life style is associated with decreased cardiac mass, decreased transport capacity of vasculature in cardiac and skeletal muscle and diminished endothelium-dependent dilation (EDD) of arteries. The purpose of this presentation is to briefly summarize and critically evaluate what is known about the cellular and molecular mechanisms responsible for the effects of PIA and high fat diet on vascular function, mainly citing the studies resulting from the Program Project Grant at the University of Missouri.

In the absence of disease, the decreased transport capacity in cardiac vasculature results from structural vascular remodeling (decreased diameters of arteries, decreased density of arteries and capillaries). Current evidence indicates that PIA alters expression of a number of endothelial cell (EC) genes (eNOS, SOD-1, Cav-1). Either hyperlipidemia or PIA impairs endothelial function by attenuating nitric oxide- (NO-) mediated relaxation. Removing physical inactivity with exercise during hyperlipidemia rescues the loss of endothelial function through a non-NO pathway. PIA alters smooth muscle (SM) contractile responses to agonists. PIA increases in vitro coronary artery contractile forces to endothelin by increasing Cai. PIA increases SM sarcoplasmic reticulum (SR) Ca<sup>2+</sup> content due to lower Ca<sup>2+</sup> unloading through ryanodine receptors from the SR without a change in intracellular free Ca<sup>2+</sup> (Cai). Altered calcium regulation likely contributes to the increased contractile responses to vasoactive agents, as well as influencing SM phenotype. Paradoxically, endothelin-stimulated Ca<sup>2+</sup> influx was decreased across the sarcolemma by PIA. L-type voltage-gated Ca<sup>2+</sup> channel (L-VGCC) activity was decreased by PIA only in female pigs. However, feeding male pigs a high-fat diet atherogenic diet decreased L-VGCC in coronary SM. PIA decreases the relative contribution of both KCa and Kv channels to the regulation of basal tone of SM coronary arteries. PIA also turns down K<sup>+</sup> channel activity with a consequent promotion of endothelin-mediated vasoconstriction.

## S103A-2

**Gene expression: Training and diet interaction****Saltin Bengt**

University of Copenhagen, Rigshospital, Denmark

No Abstract

## S103A-3

**Mechanisms involved in the plasticity of the contractile apparatus in human skeletal muscle****Harridge Stephen**

University College London, United Kingdom

*Keywords: muscle, IGF-I, myosin*

Muscle has shown itself to be a highly plastic tissue being able to adapt to the variety of challenges placed upon it. The adaptations to these challenges involve the suppression of some, and the upregulation of other, specific genes. In some animals, chronically electrically stimulated fast muscles have been induced to become slow muscles. We have recently chronically stimulated the tibialis anterior muscle of spinal cord injured subjects (Harridge et al. 2002) and shown that such a remodelling may be evoked in human skeletal muscle. This was evidenced not only in the down regulation of the fast MHC-IIx gene, but also in the upregulation of the slow MHC-I gene.

In contrast, high load or resistance type exercise results in muscle hypertrophy. In this regard the role of locally produced IGF-I in muscle has been the subject of recent interest. It is becoming apparent that alternative splicing of the IGF-I gene may result in at least 3 isoforms of IGF-I which seem to differ in their, expression kinetics and physiological functions. Two of these have recently been studied in human skeletal muscle (Hameed et al. 2003). IGF-IEa is similar to the liver type IGF-I, whilst a second isoform is mechano-sensitive and has been termed 'MGF'. Exons 3-5 of the IGF-I gene encode for the mature peptide, which upregulates protein synthesis, whilst MGF, which also has this region, appears to work by activating the satellite cells. Down stream from the IGF-I receptor a cascade of intracellular signalling events ultimately results in increased protein synthesis. One of these steps, the phosphorylation of P70-s6 kinase, has been shown to correlate with muscle hypertrophy (Baar & Esser 1999). Importantly, the phosphorylation of this protein kinase may also be brought about by nutritional means through the administration of leucine. This nutritional intervention has also been shown to increase rates of protein synthesis. The interaction between these nutritional and exercise induced events may work in synergy to enhance the adaptive process.

*Baar & Esser (1999) Am J Physiol 276:C120-C127. Hameed et al. (2003) J. Physiol. 547: 247-254. Harridge et al. (2002) Muscle & Nerve 25:685-694*

## Oral Session

## Physiology 3: Hypoxia

O103B

## O103B-1

**Heart rate and blood pressure responses to apnea and exercise****Smerecnik Mirco, Hoffmann Uwe, Leyk Dieter**

German Sport University Cologne, Germany

*Keywords: apnea, breath-holding, rebreathing*

We sought to investigate cardiovascular responses to breath hold and rebreathing combined with intensive dynamic exercise. Breath-hold for several seconds frequently occurs in several sportive activities. The hypothesis whether baroreflex mediates the response of heart rate (HR) and mean arterial blood pressure (MAP) to apnea combined with exercise and Valsalva maneuver, respectively. As consequence of these combined stresses different competing physiological reflexes and regulation processes are activated.

In the first series we tested 15 healthy sports students performed 20 s bicycle exercise at 250 W/60 rpm combined with apnea (A&P250W) with 20 mmHg mouth piece pressure (MPP), free breathing (P250W) and apnea with a workload of 30 W (A30W) in supine position, all preceded by 280 s of 30W/60 rpm pedalling. In the second series we tested 11 subjects and we modified the first series and replaced apnea by rebreathing (RB250W, RB30). Breathing valve was under subjects control, mouth piece pressure (MPP) and pedalling frequency were continuously monitored to the volunteer on a LCD. HR and MAP were continuously recorded.

We observed a marked fall in HR and increase in MAP in the last 5 s during the 20 s apnea period (A&P250W). In the rebreathing attempts we observed a HR stabilisation, but no remarkably increase of MAP.

We conclude that the breath-hold is the significant stimulus, which superpose the exercise stimulus for HR and MAP. The maintained breathing movements during the rebreathings attenuate the bradycardia and the MAP, thus the cardiovascular response seems to be determined more by the respiratory arrest. However, a chemoreceptor controlled O<sub>2</sub>-conserving mechanism during apnea seems to have a subordinate role.

Ahn B et al (1989). *Eur J Appl Physiol* 59: 146-51Eldridge FL (1994). *Med Sci Sport Exerc* 26 (3): 319-24Lindholm P et al (1999). *J Appl Physiol* 87 (6): 2122-2127

## O103B-2

**The ventilatory response to exercise in acute hypoxia: a putative role for prostaglandins****Burtscher Martin, Likar Rudolf, Philadelphia Michael, Patterson Carson, Nachbauer Werner**

Institute of Sport Science, University of Innsbruck, Austria

*Keywords: high altitude, exercise response, prostaglandins*

L-arginine-L-aspartate is widely used by athletes for its potentially ergogenic properties. It has been reported to increase exercise performance. However, most published studies did not use standardised test procedures, were not controlled, and investigated drug effects only on a restricted scope of performance. Thus, we evaluated the effects of

prolonged intake of L-arginine-L-aspartate on a broad spectrum of motor performance.

27 healthy volunteers (21±2 years) were randomly assigned to the L-arg.-L-asp. group (8 females, 5 males) or to the control group (8 females, 6 males). A daily dose of 1 gram of L-arg.-L-asp. was administered for 3 weeks. Tests of maximum isometric and dynamic muscle strength, aerobic and anaerobic endurance capacity, reaction times, maximum running velocity, and motor coordination were performed before and after the 3-week treatment period. Physical activity was standardised for both groups throughout the study.

All study participants completed the experiment without any problems. Out of all tests carried out only maximum endurance performance on the cycle ergometer tended to be increased and blood lactate concentrations during submaximal work on the ergometer were diminished after 3 weeks of L-arg.-L-asp. compared to control conditions. Blood lactate concentrations at 150 watt declined from pre- to post-tests by  $-0.44 \pm 0.27$  mmol/l after L-arginine-L-aspartate and remained unchanged in the control group ( $0.0 \pm 0.32$  mmol/l) ( $p < 0.01$ ). The accuracy of aim was even slightly reduced in the L-arginine-L-aspartate group ( $-0.59 \pm 0.65$  scores) in comparison to the control group ( $+0.22 \pm 1.1$  scores) ( $p = 0.03$ ).

Because we did not perform a placebo-controlled study these findings must be interpreted with caution. Nevertheless, a right shift of the lactate-performance curve and thus an improvement in aerobic performance may be assumed after prolonged intake of L-arginine-L-aspartate. This is well in accordance with prior findings.

## O103B-3

**The effects of high-intensity training under hypobaric hypoxic conditions on metabolic capacity and high-intensity exercise performance****Ogita Futoshi, Yamamoto Akito, Kotake Naoki, Tamaki Hiroyuki, Wagatsuma Akira**

National Institute of Fitness and Sports, Japan

*Keywords: high altitude training, maximal accumulated O<sub>2</sub> deficit, high intensity training*

Training at altitude has been primarily performed for the purpose of improving O<sub>2</sub> transport system, i.e. maximal aerobic power (VO<sub>2</sub>max). On the other hand, several studies recently reported that maximal accumulated O<sub>2</sub> deficit (MAOD) and buffering capacity increased after altitude training (Mizuno et al. 1990, Ogita and Tabata 1999), and the possibility that the altitude training may improve effectively anaerobic energy releasing system was suggested. Therefore, the present study aimed to examine whether high-intensity training under hypobaric hypoxic conditions improves metabolic capacity and high-intensity exercise performance.

The subjects were 12 well-trained college male swimmers (21±1 yrs). They were matched for physical fitness level into two groups and then randomized to normobaric normoxic training group (N, n=6) and hypobaric hypoxic training group (H, n=6). The training was performed in swimming flume



located in a chamber where atmospheric pressure could be regulated. Three types of training were conducted; 1) fifteen 2-min bout at OBLA separated by 15-s recovery, 2) five sets (2-min bout at 50%VO<sub>2</sub>max plus 3-min bout at 100%VO<sub>2</sub>max), 3) eight or more 20-s bout at 170%VO<sub>2</sub>max separated by 10s recovery. H had the training 1) and 2) in the hypobaric condition corresponded to 1600m above sea level and the training 3) in 2400m above sea level. H was exposed to hypobaric hypoxic condition for 2.5 hours/training session, 2 times/day, 5 days/week, for 3 weeks. Before and after the training period, VO<sub>2</sub>max, MAOD, and the swim time of 100m and 200m maximal swimming were determined.

After the 3 weeks of training, VO<sub>2</sub>max significantly increased in both N and H. No significant difference was observed in the increase ratio of VO<sub>2</sub>max between N (12%) and H (12%). MAOD also significantly increased in both groups, however, the increase ratio of MAOD was significantly higher in H (29%) than N (14%) ( $P < 0.05$ ). The swim times of 100m and 200m were also improved significantly in both groups, and the improvement of the swim time in N was almost the same as that in H.

These findings suggest that the high-intensity training could contribute to induce a large improvement of metabolic capacity and high-intensity exercise performance in both conditions but that the training under hypobaric hypoxic conditions would be favorable for the improvement of the ability to supply anaerobic energy such as MAOD rather than VO<sub>2</sub>max.

#### O103B-4

### Alterations in cellular calcium signalling in human lymphocytes after hypoxia

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**Keywords:** calcium, lymphocytes, hypoxia

Microenvironmental changes in oxygen partial pressure, caused by both pathological, e.g. ischemia, or physiological conditions, e.g. exhaustive exercise, have important effects on cellular signal transduction. The aim of the present study was to determine the influence of hypoxia on cellular calcium signalling and proliferative activity in human lymphocytes.

Human lymphocytes were isolated by density gradient centrifugation. Cells were incubated in medium at 37°C either under normoxic (75% N<sub>2</sub>; 5% CO<sub>2</sub>; 20% O<sub>2</sub>) or hypoxic (92% N<sub>2</sub>; 5% CO<sub>2</sub>; 3% O<sub>2</sub>) conditions for up to 1 hour. After reoxygenation cellular free calcium concentration ([Ca<sup>2+</sup>]<sub>i</sub>) was determined spectrophotometrically using the calcium sensitive dye Fura-2. Cell proliferation was determined by fluorescent cell division tracking using the fluorescent dye carboxyfluorescein succinimidyl ester.

Basal intracellular calcium concentration of cells after normoxic incubation was 25.8±1.2 nmol/l. In contrast, cellular calcium concentration increased in a time-dependent fashion up to 230.1±16.6 nmol/l after 1 hour under hypoxic conditions. Moreover, phytohemagglutinin (PHA) induced calcium transients decreased after hypoxia, while calcium mobilization via the CD3-receptor by OKT-3 was not affected. Performing the hypoxic incubation in calcium free medium or in the presence of lanthanum prevented the increase in basal calcium and restored the agonist induced calcium transients. The latter effect was also observed after pre-incubation of cells with a calpain inhibitor. Cell proliferation decreased linearly with time of hypoxic incubation. Hypoxia induced inhibition of cell proliferation

was partially reversible after pre-incubation cells with a calpain inhibitor.

In lymphocytes, hypoxia induced an increase of basal intracellular calcium preferentially by an influx of extracellular calcium. Furthermore, hypoxia inhibited differentially stimulus-induced intracellular calcium transients and cell proliferation. These effects seemed to be mediated specifically by a calcium dependent protease as indicated by the effects of the calpain inhibitor.

Mooren FC et al (2001). *Med Sci Sports Exerc* 33 (2): 242-8

#### O103B-5

### High hematocrit leads to low performance in mice

**Heinicke Katja, Djonov Valentin, Vogel Johannes, Gassmann Max, Wagner Peter**

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**Keywords:** EPO overexpression, excessive erythrocytosis, muscle degeneration

To test the impact of excessive erythrocytosis on exercise performance we made use of our transgenic mouse model that due to constitutive, hypoxia-independent overexpression of human erythropoietin reaches hematocrit levels of up to 90%.

We measured hematological and hemodynamical parameters in wild type and transgenic mice and compared their exercise performance as determined by a swim test. In turn, we analyzed skeletal muscle by histology and immunohistochemistry using CD31 antibodies to visualize endothelial cells.

At rest, erythrocytotic mice did not show any alterations of blood pressure, heart rate or cardiac output. While transgenic mouse plasma volume was not elevated, whole blood volume in transgenic mice was as high as 25% of the body weight. Exercise performance in 5 months old transgenic mice was dramatically impaired: while wild type siblings kept constant swim speed during 2 min, the transgenic ones drastically reduced their performance after 40 sec. Interestingly, at 7 months, some of the transgenic mice showed hind limb tremor and toddle which increase progressively and the animals suffer from signs of complete paraplegia. Life expectancy of transgenic animals was reduced to 7-9 months compared to a life span of 18-24 months found in wild type controls. Preliminary analysis of 5-6 months old Epo-mice reveals severe degenerative processes in the skeletal muscle presented as fiber hypertrophy and altered vascular density. At this age first signs of muscular decompensation by overloading are detectable and morphologically represented by i) vacuolization of the muscle, ii) irregular endomysial clefts with tendency to fiber solidification, iii) focal, scattered fiber atrophy, and finally iv) in some areas a dramatically decreased capillary density.

Despite the dramatic increase in hematocrit, transgenic animals did not show clinical symptoms until 7 months. At this time some of the animals developed hind limb tremor. Obviously, cage-confined animals without any challenge are able to cope with this excessive erythrocytosis. When challenged by exercise, however, transgenic mice were poor performers most probably due to muscular degeneration and/or hemodynamical complications. Taken together, our preliminary data provide good evidence that long-term, Epo-induced excessive erythrocytosis results in impaired exercise performance and skeletal muscle degeneration.

## O103B-6

**Oxygen uptake during wingate test for arms and legs in swimmers and water polo players**

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*Keywords: swimming, oxygen uptake, water polo*

The aim of the present study is to compare the values of the VO<sub>2</sub> during two consecutive Wingate tests for arms and legs in swimming (S) and water polo (WP).

Sample - seven national level athletes (4 S and 3 WP), age 17.90±2.14 years, body mass 71.41±6.84 kg, height 176.65±7.02 cm, % body fat 13.23±4.18. Two Wingate bouts with 30 sec each with 3 min interval between them, for arms and legs in alternated days. Oxygen uptake: breath-by-breath using the gas analysis system K4 b2 Cosmed. Statistical analysis: Wilcoxon Test and Kolmogorov-Smirnov Test.

The mean values found at the VO<sub>2</sub> peak (PVO<sub>2</sub>), mean power (MP) and peak power (PP) for each bout Wingate Test, for arms and legs. Arms: PVO<sub>2</sub>=55.16±5.72 ml.kg<sup>-1</sup>.min<sup>-1</sup>, MP=5.28 ±0.59 Watts.kg<sup>-1</sup> and PP=6.71±0.88 Watts.kg<sup>-1</sup> get in the first bout (1<sup>a</sup> Arms) and PVO<sub>2</sub>=60.12±6.10 ml.kg<sup>-1</sup>.min<sup>-1</sup>, MP=5.03±0.40 Watts.kg<sup>-1</sup>

and PP=6.25±0.51 Watts.kg<sup>-1</sup>, get in the second bout (2<sup>a</sup> Arms). Legs: PVO<sub>2</sub>=55.66±6.85 ml.kg<sup>-1</sup>.min<sup>-1</sup>, MP=4.75 ±1.79 Watts.kg<sup>-1</sup> and PP=7.44±1.96 Watts.kg<sup>-1</sup> get in the first bout (1<sup>a</sup> Legs) and PVO<sub>2</sub>=62.09±5.99 ml.kg<sup>-1</sup>.min<sup>-1</sup>, MP=4.28±1.47 Watts.kg<sup>-1</sup> and PP=6.68±11.63 Watts.kg<sup>-1</sup> get in the second bout (2<sup>a</sup> Legs).

The PVO<sub>2</sub> mean values found on Wingate Test for legs and arms did not present significant differences. On other hand, there was a significant difference between means of the first and second bouts for PVO<sub>2</sub> for arms (p<0,05), and there was just a trend to significant difference on the means between the first and second bouts for legs (p=0,06), characterized by a great physiological adaptation of the aerobic component, the specificity of training type for arms in contrast with the legs. This fact should be better explained by the observation of the mean values of the MP, each on first and second bouts for arms, that is, the S and WP generated a MP more constant with arms than legs; and the second bout mean was significant smaller than the first bout (p=0,025). A similar behavior was observed in the means values of PP; it was a tendency significant difference between the means on first and second bouts for legs (p=0,06).

It looks like to exist a great facilities for O<sub>2</sub> adjust for arms than legs, what could be associated to specific demands that the S and WP athletes are daily submitted in the training.

**Oral Session****Physical Education/Philosophy****O103C**

## O103C-1

**Application of the model theory for conceptualizing a content structure for sport science as an academic discipline**

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*Keywords: model theory, content structure*

The fast developing academic field of sport science has to evaluate its content structure from time to time. In this analysis model theory as basic scientific theory will be used for the development of an up-to-date content structure of sport science.

It has been a long development during the last 50 years from a field called physical activities ("Leibesübungen") to physical education ("Leibeserziehung") and finally sport science ("Sportwissenschaft") comprising a wide range of subdisciplines and topics from the natural-medical, the social-behavioural-educational, the political-economical, and cultural (humanities) science point of view.

Several departments are recognized and included in this analysis, e.g. the content specialisation and differentiation of the academic world, the quest for thinking and working in an integrated and interdisciplinary way, and the development as promoted by ICSSPE, the umbrella organisation of sport sciences on the world level.

Furthermore, it is recognized in this analysis that within the discussion related to the philosophy of science ("Wissenschaftstheorie") several paradigms have been developed which had to be considered in the process of conceptualizing a content structure for sport science: the intra- and inter-paradigm, the distinction of theory- and theme fields, the threefold perception of practice related to motor practice, professional practice, and practice as social reality,

a triadic perception with movement, play and sport and a pluralistic approach to research methodology for the wide range of aspects of sport science a bidirectional perception of practice to theory and theory to practice.

As a result an up-to-date model for the content structure is developed in this analysis.

A clear and logic structural model for describing the content of sport science is presented based on these developments and paradigms. This content structure is related then to various aspects of the academic discipline of sport science as related to its research and teaching dimension. In this context the following issues are discussed briefly: Installation of professorships and shaping the infrastructure of units for sport science in higher education; developing an organisational network for sport science and a network with different categories of information sources.

Finally the content structure of sport science has to be seen in close relationship with three other issues which are part of the discussion on the nature and selfunderstanding of sport science: function, research methodology and science transfer.

## O103C-2

**Equality of opportunity in sport - an ideal and its consequences**

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*Keywords: ethics, justice*

The paper suggests an interpretation of the ideal of equality of opportunity in sport and discusses its consequences in a critical and systematic way.

The method is practical argumentation inspired by Rawls' (1971) influential idea of a reflective equilibrium in which general principles and considered judgements in practical situations are brought into coherence.

In the first part, the ideal of equality of opportunity in sport is defined more detailed. The social structure of sport competitions implies the measuring, comparing, and finally ranking of participants according to performance as defined by the relevant rules. The ideal of equality of opportunity implies the elimination of, or at least the compensation for, what are considered non-relevant inequalities. In sport, the general idea is that these are inequalities upon which the individual cannot exert influence in any significant way, and for which the individual is not fully responsible (Loland 2002). In a second part, practical implications of the ideal are presented and tested in terms of reasonableness in actual cases.

First, the ideal of equal opportunity requires identical, or sufficiently similar, external conditions. In practice, this is done by various standardization procedures for facilities and equipment. Particular challenges are discussed linked to actual inequalities in equipment, and in climatic conditions in outdoor sports.

Secondly, the ideal of equality of opportunity has implications for person-specific inequalities. For instance, in most sports, competitors are classified according to age and sex, and, in sports in which body size is crucial to performance, according to weight. The paper discusses what are considered to be too fine-grained classification in some sports, and a lack of necessary classification in other sports.

Thirdly, the ideal of equality of opportunity is relevant in the discussion of inequalities in sport system strength. One consequence of the interpretation above is that if inequalities in economic, technological and scientific strength exert strong impact on performance, these inequalities ought to be eliminated or at least compensated for. The paper discusses some rather radical, practical consequences of this idea in modern sport.

Loland S (2002). *Fair Play in Sport*. London: Routledge

Rawls J (1971). *A Theory of Justice*. Cambridge: Harvard UP

### O103C-3

#### To what extent can Rawls's philosophical method of "reflective equilibrium" contribute to decision-making in elite tennis?

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Keywords: tennis, ethics, philosophy

Tennis like any other social practice undergoes challenges and revisions to its nature. A number of technical and technological innovations have recently been implemented including the introduction of shorter sets and tie-breaker sets, and a revised tennis seeding structure. These innovations, if adopted, will represent a new instantiation of the game. The aim of this paper is to determine how decision makers ought to select the criteria to justify technical and technological innovations that will benefit tennis while simultaneously safeguarding the integrity of the sport. I explore Rawls's (1971) method of "reflective equilibrium" as a philosophically grounded decision-making method for the rational evaluation of technical and technological innovations in elite tennis.

I set Rawls's (1974/75) method of "wide reflective equilibrium" in the context of the elite tennis seeding procedure introduced at the 2001 Wimbledon championships. Then I discuss critically the objection that "wide reflective equilibrium" disregards the diversity and the

moral importance of the different cultures in which people live generally, and the different ways in which tennis can be played. I argue that the universal and cross-cultural nature of the method of "wide reflective equilibrium" disregards the way in which people are dependent on their culture for the way in which they think about themselves and how they ought to live their lives in and out of sports. The method promotes an understanding of (sports) cultures as cooperative projects for individual gain; as a fundamentally private association created by individuals whose interests are defined independently of the community they are members of. Thus, the method of "wide reflective equilibrium" is too far removed from the practice of elite tennis, its ethos, histories and traditions, to have any normative force. I conclude that whilst "reflective equilibrium" is a praiseworthy procedure for evaluating technical and technological innovations in elite tennis it is too "thin" a method since it disregards the diversity and the moral importance of the different cultures in which people live in general and tennis more specifically.

Rawls J (1971). *A theory of justice*

Rawls J (1974/75). *The independence of moral theory*

### O103C-4

#### Gymnastics' contribution to sport aesthetics

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Keywords: gymnastics, aesthetics

Some sports obviously bear the practical stamp of aesthetics. In sports such as gymnastics, synchronized swimming, diving or figure skating, we are further removed from real world concerns of usefulness and measurement. These kinds of sports are, in a certain way, closer to aesthetic criteria. Not worried about amounts of space covered or time elapsed, we attend exclusively to the look of the body in motion. Most scholars agree about this although there is a lack of information related to this subject based on empirical data. This study's main goal was to inquire, from the aesthetic point of view, a direct intervention group in sport about their appreciation of gymnastics. The purpose was to substantiate (or refute) the literature.

The sample was composed of a group of Sport Sciences university professors (n=95) who answered an intensity scale questionnaire (from 1-none aesthetic value, to 5-much aesthetic value), to find out the importance ascribed to the following gymnastics' disciplines: rhythmic, artistic, acrobatic, aerobics and trampoline. Statistical handling included mean and standard deviation.

The results prove that rhythmic gymnastics was the most quoted in terms of its aesthetic value (4.58): this discipline has an aesthetic judgment in competition with a considerable value: 10.0 points are attached to artistic value. Artistic gymnastics (4.46), acrobatics (4.35) and trampoline (4.11) came next: in these disciplines the acrobatic element is absolutely essential. It was shown that the degree of difficulty provides an added aesthetic value. Aerobics (3.70) came in last place: perhaps the characteristic of being too energetic and the intensity of music and movement, along with a kind of a very typical expression, lead inquirers to a lower valorisation.

Kupfer J (1988). *Sport - The body electric*, In: William J et al, *Philosophic inquiry in sport*, 455-75. Human Kinetics Pub

Lacerda T (2002). *Elementos para a construção de uma Estética do Desporto*. Dissertação de doutoramento. Porto, FCDEF-UP

Osterhoudt R (1991). *The philosophy of sport: an overview*. Champaign, Illinois: Stipes Publishing Company

## O103C-5

**Professions and values in children's sport****Christensen Mette**

University of Aarhus, Denmark

*Keywords: values, profession, partnership*

Physical activity is one of the core values in the upbringing of children for many reasons. The pedagogical and educational discourse, which this paper lies within, is also concerned to children's physical activities including children's sport (Arnold 1979, 1990). There seem to be a wide range of values (van Deth & Scarbrough 1995) represented in this discourse. The object of the research project Professions and Values in Children's Sport is: How are values in sport reflected in children's different sports places and how is it possible to develop a partnership among professions dealing with children's physical activities and sport in order to strengthen the feasibility for children to be physical active and do sport?

The study is based on a two year development project in Denmark (2001-2003) that focuses on three professions (PE teachers, after-school teachers and coaches), their values in sport and the possibility of partnership. The assumption is that these professions, by virtue of different educations and practices, represent and reproduce different values (Bourdieu 1990). A survey study (N=132) and a focus group study (N=22) among the three professions are exploring the values and working relationships in relation to sport. An interview study (N=39) among children (8-10 years) is exploring the children's values in relation to physical education, movement activities and sport.

The results indicate that the professions share a relatively common understanding of competences relevant to their work with children and sport, but they point to three different values in sport: physical activity and movement skills (PE), play (after-school), and social learning/being together in a group (coaches). The results also show that the development of partnership across professions is difficult, mainly because of different cultures of practice, but also because of different values and concepts of sport. Finally the results show that, to a considerable extent, children differ between the values of PE, movement activities in the after-school center and doing sport in the sports club.

In relation to the development of partnership across professions dealing with children's physical activity, different values in sport is both a limitation, because opposite values do not spontaneously inspire an engagement in partnerships, and a challenge, because different values cover different needs and interests among the children.

Arnold PJ (1979). *Meaning in Movement, Sport and Physical Education*

Arnold PJ (1990). *Education, Movement and the Curriculum*

Bourdieu P, Passeron JC (1990). *Reproduction in Education, Society and Culture*

van Deth JW, Scarbrough E (1995). *The Impact of Values*

Handal G, Lauvaas P (1987). *Promoting Reflective Teaching: Supervision In Practice*

## O103C-6

**The role of parental support in sports success of talented young Dutch athletes****Visscher Chris, Elferink-Gemser Marije, Lemmink Koen**

Institute of Human Movement Sciences, The Netherlands

*Keywords: parental support, talented young athletes, sport success*

To determine whether a difference exists in parental support of more successful and less successful athletes, parental support was divided in serving as a role model and stimulation of athletic involvement. Parents serve as positive role models, if they themselves, are presently active in sports and/or have been in the past. Stimulation of athletic involvement was divided into three components: financial support, emotional support and the importance of success in sports.

In the 14-16 age bracket, 254 talents filled in a questionnaire (135 boys and 119 girls). We utilized a 4-point and 5-point Likert scale. The talents were members of the selection team in one of the following sports: soccer, volleyball, field hockey, tennis, speed skating and judo.

Two years later the trainers considered the athletes as more successful when they still performed at the highest national level for their age and category. This information on performance was available for 228 athletes. Of this group 61.8% were still performing at a high level, whereas 38.2% were no longer performing at a high level.

With regard to how far parents served as positive role models for their children, over 90% fulfilled this role at least in some way. Still, a difference was found between more successful and less successful athletes. No difference was found between the two groups for financial support. Over 75 % of all parents give at least some emotional support, but a difference remains. The more successful athletes received more emotional support from their parents. No difference was found between the two groups for the "importance of success" variable. In both cases, at least 90% of all parents believed that their children's achievements in sports were (very) important.

As with all results, the differences found, already existed when all athletes were still considered to be talented, and it was not clear yet who would become more successful.

This study showed clearly that differences exist in parental involvement between athletes of varying degrees of success. Parents of more successful athletes provide a better role model for their children's athletic achievements, as well as more stimulation towards better sports achievements. In this respect, it is only concerning emotional support that a significant difference was found between the two groups.

## Symposium

## Psycho-Social Aspects of Rehabilitation

S103D

## S103D-1

**Initiation and maintenance of physical exercise: Stage-specific effects of a rehabilitation program****Lippke Sonia, Fuchs Reinhard**

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*Keywords: modelling, tailored interventions, discontinuity patterns*

Patients in a rehabilitation program are at risk for physical inactivity. The rehab aims to drive all patients to be decided to start recommended regular physical activities. Although, all persons have a high intention to start, many of them fail. Interventions might be tailored to the targeted individuals. Several studies indicate that stage-specific interventions are more effective than general interventions. In our investigation subjects were classified into three stages: (a) predecisional (no decision to engage in a regular exercise program), (b) postdecisional-preactional stage (the decision is made to engage in regular exercise programs, but the person has not started yet), and (c) actional stage (the person is performing exercise programs on a regular basis). It was hypothesized that the rehabilitation will influence the patients differently according to their stage at the beginning of the program.

In an ambulant rehabilitation center, patients were recruited at the beginning of their stay (N = 502). They were asked to fill out a self-administered questionnaire to assess the exercise stage and the level of all physical activities (also for locomotion, recreation and household/care giving/gardening) prior to the beginning of the rehab. About two weeks after finishing the rehab program patients were called at home and asked about all their currently performed physical activities.

At the beginning of the rehab program, regarding to intended physical exercises, 25% of the patients were diagnosed in the predecisional stage, 28% were classified as preactional and 47% were actional. All groups are performing some physical activities (sessions/week: predecisional patients 3,5; preactional patients 3,8; actional patients 6,5). Only the persons in the actional stage are active enough to meet the medical recommendations. After the rehab, the predecisional and preactional patients have become significantly more active (plus 1,2 session/week). However, the patients in the actional stage have decreased their physical activities. Obviously, they have some problems to get back on their former level of physical activities.

The results suggest that the behavioural effects of the rehabilitation program are stage-specific. Patients in the predecisional and preactional stages prior to the rehab program benefit strongly from the rehab. Already actional patients should get more specific support to return to their former activity levels. These findings have implications for tailored interventions as well as of stage models of exercise and health behaviour.

## S103D-2

**The physical self in therapy and rehabilitation****Fox Kenneth**

University of Bristol, England

*Keywords: exercise, self-esteem*

Self-esteem is considered to be a key contributor to mental well-being. It is closely related to emotional adjustment and positive attributes and achievement. Low self-esteem, reductions in confidence, and other symptoms of depression often accompany serious life events such as heart disease or traumatic injury. The self is therefore seen by many therapists as central to recovery. The physical self has increasingly been studied as an independent and measurable aspect of the whole self. Self-estimates of elements of physical function such as sport competence and physical strength and condition as well as perceptions of appearance contribute to an overall sense of physical self-worth. Physical self-worth is consistently related to global self-esteem and many theorists believe this is because the physical self functions as the public representation of the self. Indeed, some studies have indicated that physical self-worth has direct links to measures of emotional well-being, independent of self-esteem or socially desirable responding. What we feel about how well our bodies function and what they look like can therefore be important to both our overall sense of worth and mental well-being. Improved measurement of the physical self has encouraged its study as a key mediating construct between various therapeutic modes and more global indicators of well-being including self-esteem. Several studies featuring partial correlation analyses or structural equation modelling have confirmed its mediating function between exercise and self-esteem. Although studies have tended to be cross-sectional, a small number have begun to use multidimensional physical self-perception profiles such as the Physical Self-Perception Profile or the Physical Self-Description Questionnaire in therapeutic settings involving exercise, some of them experimental in design. These include rehabilitation from depression and anxiety, sports injury, alcohol abuse, arthritis, and heart attack. Additionally qualitative research has investigated in greater depth the role of the physical self in the management of enduring mental disorders such as schizophrenia and in recovery from diseases such as obesity. This paper summarises this area of research and discusses future approaches to providing a better understanding of the role of the physical self in rehabilitation.

## S103D-3

**Working out your depression: Utopia or euphoria?****Van de Vliet Peter, Knapen Jan, Van Coppenolle Herman**

Catholic University Leuven, Belgium

*Keywords: depression, psychomotor therapy, psychosocial rehabilitation*

Clinically depressed patients considered fitness training as a valuable component of their treatment. However, clear research evidence is missing to explain these person-specific perceptions. At the same time, a growing amount of research

addressed the issue of interrelationship between exercise and self-esteem. Because clinically depressed patients suffer from low self-esteem, and participation in regular exercise is considered to be effective with regard to increases in self-esteem, especially via increases in physical self-concepts, exercise programs might be effective means of alleviating depression in this way. This hypothesis provided the impetus for two assumptions to be tested: 1. fitness training contributes to changes in physical well-being and depressive symptoms in clinically depressed patients; and 2. the negative perception of the physical self of clinically depressed patients improves after treatment and is related to changes in self-esteem and clinical depression.

Subjects are clinically depressed individuals. Individual and combined results of clinically depressed patients are presented and discussed, using single-subject methodology and comparison of depression and self-esteem measures before and after a three-month treatment period.

Based on self-reported measures it cannot be generalised that fitness training was effective in the reduction of feelings of depression in clinically depressed patients. More than two-thirds of the patients were successful in decreasing their depressed symptoms, independent from the severity of initial depression. These changes went along with positive changes in global self-esteem.

The present findings do not support beneficial effects of fitness training towards physical well-being, although this was one of the objectives the fitness program aimed at. Additional analyses however, revealed that fitness training is associated with positive changes in other relevant aspects of the patients' functioning in individual patients. These changes represent very well the complexity and heterogeneity of symptoms in clinically depressed patients. Evidence is provided in support of an inverse depression – self-esteem relationship, but increases in self-esteem are not automatically accompanied by positive changes in physical self-perceptions.

#### S103D-4

### The effects of physical activity on quality of life responses in breast cancer, diabetic and cardiac rehabilitation patients

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Centre for Exercise Science and Medicine, Scotland

*Keywords: rehabilitation, quality of life, clinical trials*

Quality of life (QoL) has been recognised as an important outcome from physical activity interventions especially with clinical populations. Three studies on clinical populations are presented here. Each study was conducted as randomised controlled trial in which the intervention group received advice and opportunities to increase physical activity and the control group continued with usual care. QoL was an outcome variable in each study along with medical and physiological outcomes. In the first study women with early stage breast cancer who participated in a 12 week exercise programme reported significantly higher levels of QoL (measured by FACT-G) than the controls. In the second study people with type 2 diabetes who received an exercise consultation 1 month and 6 months after enrolling in the study reported higher levels on two sub-scales of the SF-36 (which was used to measure QoL) than the control group who did not receive the exercise consultations. The two sub-scales were role limitations due to emotional problems and physical functioning. In the third study cardiac patients received an exercise consultation 1 and 6 months after completing a supervised hospital programme of exercise. The controls, who did not receive the additional exercise consultation, reported deteriorating scores in role limitations due to emotional problems and energy sub-scales of the SF-36 while the intervention group showed a consistent pattern of improvement at both 6 and 12 months. Overall these results suggest that physical activity/exercise has beneficial effects on the how these clinical populations view the quality of their lives, which may deteriorate over time without intervention. It is recommended that all studies examining the benefits of physical activity for clinical populations measure quality of life as one of the outcomes.

## Oral Session

### Sociology 1

**O103E**

#### O103E-1

### Women's football in Austria - from the "Sleeping Beauty" to the kick off into a new millennium

**Dikemüller Rosa**

Institute of Sport Science, Austria

*Keywords: football, cultural studies*

Football is widely regarded as a "man's game" in which women are still seen as marginal. In the following paper the situation of women's football in Austria from the early beginning in the 1920s, its interdiction in 1936, its rebirth in the late 1960s and its slow increase until 2000 is described. However this is beginning to change. In addition to the theories of gender and cultural studies the focus of the analysis lies on the different kinds of arguments in the long history of hindrance but also on different perspectives for the Women's football in Austria.

In a first step the development and status quo of women's football in Austria is described. The emphasis of the hermeneutic interpretation of the data lies on the, in part, quite different means of argumentation with which it was sought to keep women out of football. The discussion revolves around various reasons why in our country still today relatively few women are involved in football and how the sport itself has remained a male domain par excellence. Via interviews with experts in the field of football different strategies for the future are elevated.

Yet women's football is not exclusively burdened by marginalisation; this affects other sports in which girls and women are active. It is not uncommon that the sport is dubbed as one of the "last" male domains, in which particular gender hierarchies are reproduced and cemented. On the other hand, sports and football present not simply microcosms of society, but influence significantly independent ways of cultural practice. In these practices, men and women are not only to be seen as victims of existing controlling structures, but also as shapers of social change processes.

The analysis of the development of Austrian's women's football and the results of an interview study must also be viewed from the perspective of the "doing gender", which is ingrained in the very specific cultural, political and economic conditions in Austria.

Compared to other western industrial nations the situation of Austrian women's football can be characterized depicted as quantitatively and qualitatively underdeveloped. Football functions as a refuge of masculinity and is dominated and controlled by men. In the conclusion different developing visions for a (gendered) global play are discussed. Women's football hope to profit specifically from the recent agreements reached in sports policy regarding gender mainstreaming as these are put into practice and thereby gain a long necessary impulse for its development.

### O103E-2

#### **Sport and the integration of minority women**

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*Keywords: minorities, multiculturalism*

During the last ten years in Europe several countries have begun to use sports as a means and arena for integration of minorities into the society. There seems to be a common understanding among the countries that sport is a well suited arena for the integration of minorities. While there is a growing amount of sophisticated research on minority men and sport, there are very few studies on minority women and their sport participation.

The questions asked in this paper are therefore: "What is the possibility of integration of minority women through sport?" And "What are the constraints for minority women's integration into sport?"

Internationally, there is a growing amount of studies on minorities and their sport participation. This paper will be based on a literature review of the research that has been published from the 1990s to the present time. The analysis is limited to research conducted in Europe.

Most of the studies done on minority women focuses on their lack of participation in organized sport and explains this by the cultural and religious barriers that are preventative (Strandbu and Bjerkeset 1998). Some of the newer research, however, seems to have moved the focus from culturally internal constraints toward racism and constraints in the majority sport organizations (Lovell 1991). Findings indicate that cultural and religious barriers as well as racism have different impacts on African women when compared with Asian women. Asian women are experiencing more cultural and religious barriers than African women, and African women are experiencing more racism than Asian women.

One might say that the diversity among women inside the broad categories of "African" or "Asian" has not been captured by previous research. This might have led to a reinforcement of stereotypes about minority women and sport. There also seems to be little focus on the lack of accordance between a country's multicultural integration policies and the way sport is organized in that same country. This gap has important consequences for minority women because minority women are often seen as "bearers" of the different ethnic groups' cultural identities. As a consequence, minority women's need for a multicultural integration climate in sport is greater than it is for minority men.

*Lovell T (1991). Sport, Racism and Ethnicity.*

*Strandbu Å, Bjerkeset S (1998) Ungdom og idrett i et flerkulturelt samfunn. Oslo, NOVA.*

### O103E-3

#### **Enhancing quality and quantity of youth sport through the co-operation between school, sports clubs and municipality in Flanders (Belgium)**

**Theeboom Marc, De Knop Paul, De Bosscher Veerle, De Martelaer Kristine**

Vrije University of Brussel, Belgium

*Keywords: youth sport, sport policy*

During the last decade, there has been an increased interest in the promotion of youth sport in several countries in Europe. Also in Flanders, the dutch-speaking northern part of Belgium, several specific sports promotional initiatives aimed at youth have been set up in the past. Although this increased attention to youth sport can be regarded as successful, a major shortcoming has been the lack of co-operation between different organisations and structures (e.g., sports clubs; schools; youth organisations; municipal and provincial sports services, etc.). In recent years, there has been a growing awareness that this situation is highly inefficient and does not necessarily contribute to an enhanced quality and quantity of youth sport. Since 2000, the Flemish government has encouraged municipalities to stimulate the co-operation with sports clubs and schools through the introduction of so-called 'Youth Sports Contracts'. Through these contracts, municipalities receive financial support when they organise youth sport activities together with sports clubs and schools.

A study was set up to analyse the first youth sport contracts in Flanders through the use of written questionnaires which were sent to the participating municipalities (43% of them replied or N=86). Also, one specific contract (located in the largest city of Flanders, Antwerp) was analysed in-depth through the use of oral interviews with representatives and semi-structured questionnaires for participating youth and for teachers.

Findings, revealed among other things, that most contracts were aimed at increasing the sports participation of youth and bringing them in contact with sports clubs. The majority of the municipalities that responded indicated that they consider co-operation with schools and sports clubs as a good and efficient way to promote youngsters to become involved in sports. One third of the municipalities that responded indicated that they had not worked together with any of these partners prior to the start of the contract. Among the most common problems that were met, were the difficulties in finding qualified teachers; the availability of sports infrastructure and attracting older youth.

Based on the results of this study, it can be concluded in general that the co-operation between school, sports clubs and municipalities within the context of youth sports promotion can offer possibilities to enhance the quality and quantity of youth sport.

### O103E-4

#### **Changes in Swedish youths' sport habits between 1968-2001**

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*Keywords: youth, habits, changes*

What changes in sport habits, organised and spontaneous, have taken place during the last decades, and how shall these changes be understood? The analyses were made against the backdrop of a societal development with altered

living conditions and lifestyles, where changing attitudes to different forms of sport are observed as well as differences in sport choices between boys and girls and also between different social groups. It is of central interest to observe the physically inactive youths and identify the conditions under which these youth live.

The present report builds upon two main studies. The first one was carried out in 1968 when 2,000 randomly chosen 15-year-old youths were asked about their sport habits during their leisure time and to what extent they were active. The second study was carried out in 2001 and put the same questions to slightly more than 800 randomly chosen youths who were 16-years old. Both studies were carried out with the help of questionnaires, which were answered under the guidance of a research leader.

The dropout rate in the studies was 12 and 18 percent, respectively.

During the past slightly more than 30 years, great changes have taken place, both in regard to the size and the type of sports performed during leisure time. Particularly noticeable is the increased proportion that, not at all or to a very insignificant extent, devotes themselves to sports. Further, the proportion of youths who spontaneously engages in sports, outside the sports clubs has decreased considerably. The organised sports nowadays support a large number of young people's physical activities during their leisure time. At the end of the 1960s, the majority of the physical activities took place outside a club's direction.

Those who very little engage in sports, and thus are very physically inactive, are characterised by, by the fact, that they are seldom members of a sports club, that they have lower grades in sports, that they live on a poorer economic standard, that the girls among them more often have immigrant backgrounds, that they have few friends who devote themselves to sports and that they do not have a good command of many sporting skills.

#### O103E-5

### Sport and society in Uruguay - theoretical and empirical remarks

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*Keywords: society, sport clubs*

Research in Latin American sport is interesting because several social scientists claim that the West is undergoing a development which could be described as Latin Americanisation. If this thesis is right, we will be able to observe a potential future of western sport in Latin America.

The presentation will first briefly describe the theoretical framework of the German sociologist Niklas LUHMANN. Society is divided in subsystems that fulfil a specific function which cannot be fulfilled elsewhere. The most important subsystems for the sport system are the political, economic, legal, educational, scientific system as well as the media. The subsystems are characterized by specialized organizations with specific values and norms written down in organizational programs, personal roles and in most cases a generalized medium of communication. The organizations of

the subsystems create the social environment for the sport system by fulfilling their function. A direct interaction with the sport system is possible but not necessary. The different media of communication (money, power, right, truth etc.) can be considered as resources that are needed in sport organizations. After that I will present empirical data concerning the history of sport in Uruguay, the social environment of the sport system, the public sports policy, club sport, governing bodies and umbrella organizations.

#### O103E-6

### Characteristics of sexual harassing coaches

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*Keywords: elite athletes, sexual harassment, coach-athlete relationship*

Traditional theories of coaching have often drawn on military metaphors to portray the strength of character and Lombardi-style commitment to toughness that is thought to characterize great coaches. Research on sexual exploitation toward female athletes indicates that this kind of coaching style can be looked upon as a risk factor for sexual harassment and abuse (Brackenridge 2001). How are harassing coaches described and characterized by the athletes themselves? Do they express some kind of specific behavior? These were among the questions asked in the study presented in this paper.

The study reports on semi-structured interviews with 19 Norwegian elite level female athletes, all of whom had experienced sexual harassment in sport by a male coach and who throughout the interview talked about the behaviour and the personality of their coach. The athletes were chosen from an earlier survey commissioned by the Norwegian Olympic Committee (Fasting, Brackenridge and Sundgot-Borgen 2000). The age of the interviewed female athletes ranged from 15 to 33 years, with a mean age of 23 years.

The analysis of the part of the interview where the athletes' where talking particularly about the characteristics of the coach - about not only their own relationship with him, but also their team-mates' relationship to the same coach, revealed that the coaches could be grouped into 3 typologies. These were: 1) 'The flirting, charming coach', characterized by always flirting, joking, trying to touch, charming etc. (8 coaches). 2) 'The seductive coach', characterized by "trying on everyone" (5 coaches). 3) 'The authoritarian coach', characterized among others by having a certain almost negative view on women in general (5 coaches).

These results mirror a traditional view of gender relations, where women (the female athletes) are objectified. The results are accordingly discussed in relation to the feminist theory with a focus on power. Implication for practice, i.e. prevention of sexual harassment in sport, and the education of coaches and athletes are also discussed.

*Brackenridge, C (2001) Spoilsport*

*Fasting, K, et al. (2000) Females, Elite Sports and Sexual Harassment*



## Symposium

## Injury Prevention and Orthotics

S103F

## S103F-1

**In vivo Achilles tendon load measurements during orthotically protected daily life activities****Lohrer Heinz, Röder Yvonne, Gollhofer Albert, Alt Wilfried, Komi Paavo**

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*Keywords: achilles tendon, functional therapy*

Achilles tendon ruptures are often the end of an athlete's career. Clinical investigations show that functional therapy provides the best treatment results. The special constructive elements of a special shoe (heel lift, stiff anterior tongue) are designed to increase gradually load systematically to the healing Achilles tendon. As the load of an individual Achilles tendon has never been determined in that specific shoe, we wanted to evaluate the modulation of the Achilles tendon tension induced by the stable shoe during normal gait and single leg stance. The optic fiber transducer (OFT) has been shown to be useful for measurements of Achilles tendon force in vivo (Komi et al. 1996, Finni et al. 1998). The aim of the study was to apply the OFT in vivo to experimentally determine loading characteristics of the stable shoe protected Achilles tendon under dynamic conditions that replicate rehabilitative activities.

Eight healthy volunteers without Achilles tendon injuries had an optic fiber implanted in one of their Achilles tendons according to the standard technique (Komi et al. 1996). The EMG activity of the M. gastrocnemius med., M. soleus, M. tibialis ant. and M. peroneus was also measured during daily life activities. An Achilles tendon orthosis, designed to protect the Achilles tendon during in the healing phase after injury or surgery was applied to the tested feet. Heel height of the stable shoe was reduced stepwise. Barefoot registration served as control condition. Calibration was performed using isometric contractions at 25, 50, 75 and 100 % MVC on an isokinetic dynamometer.

The Achilles tendon loading is reduced during all tested activities using the fully equipped rehabilitation shoe in comparison to the barefoot condition.

A relevant rest loading of the Achilles tendon exists in the tested daily life activities even wearing a fully equipped stable shoe.

The smoothed EMG curve of M. gastrocnemius med. et soleus and the optic fibre signals are fitted quite nice.

These results should be regarded in further studies dealing with Achilles tendon rehabilitation. Functional orthotic protection however results in considerably tensioning of the Achilles tendon.

*Finni, T. et al. (1998): Eur. J. Appl. Physiol. 77: 289-291*

*Komi, P.V. et al. (1996): Eur. J. Appl. Physiol. 72: 278-280*

## S103F-2

**Relationships between pain, strength of trunk muscles, spine mobility, and disability in patients with lumbar disc surgery 2 months after operation****Häkkinen Arja, Ylinen Jari, Kautiainen Hannu, Airaksinen Olavi, Herno Arto, Tarvainen Ulla, Ikkiviranta Ilkka**

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*Keywords: muscle strength, lumbar disc surgery, spine mobility*

In patients with a prolapsed intervertebral disc, prolonged periods of inactivity due to pain may lead to muscle weakness and muscle atrophy in back muscles. This study investigated the associations between pain, strength of trunk muscles, flexibility, and disability in patients with lumbar disc herniation 2 months after surgery.

172 operated lumbar disc herniation patients were examined. Instructions for stretching and mobility exercises as well as for restricted physical activities were given for the first 6-8 postoperative weeks. Back and leg pain was evaluated on a Visual Analog Scale. The Oswestry Disability Index and Short Depression Inventory were applied to assess the subjectively perceived outcome. Isometric and dynamic strength of trunk muscles and mobility of the lumbar spine were measured to mirror physical impairment.

Two months after the operation median leg pain had decreased by 87% and back pain by 81% from preoperative level, respectively. However, still moderate or severe leg pain was reported by 25% and back pain by 20% of the patients. Approximately 30% of the patients perceived moderate or severe disability measured by the Oswestry Score. Lowered muscle strength and mobility of the spine caused functional disability especially in both, older or postoperatively painful patients. Further, the ratio of trunk extension/flexion strength had changed in favour to flexion muscles being 0.98. Further, higher age (odd ratio 1.40) and depression (odd ratio 1.35) were associated with poorer post-operative recovery.

Pain, decreased trunk muscle strength and decreased mobility still existed in a considerable group of patients with lumbar disc herniation 2 months after surgery. Further, patients showed imbalance between trunk extension and flexion strength. Thus, the selected part of the patients may benefit from early identification of these restrictions and the rehabilitation should concentrate on physical conditioning and pain relieving aspects.

## S103F-3

**The shoe as a therapeutical device****Segesser Bernhard, Kaelin Xavier**

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*Keywords: achilles tendon, therapeutical shoes, motion pattern*

A shoe can serve as a therapeutical device to treat several injuries of the musculo-skeletal system by either altering or supporting certain motion patterns. It can also be used in the rehabilitation process. Hereby, the shoe can be used as an orthosis. An example is the so-called "Stabilschuh" which is

applied after injuries of the Achilles tendon or the ankle joint. In contrast to a traditional rigid fixation (cast) the application of a sportive shoe has the advantage of a decreased subjective feeling to be handicapped. Furthermore, a shoe can also alter the motion pattern in such a way that the loads of the foot are distributed differently on purpose. By doing so, a shoe can possibly correct wrong patterns as it is foreseen by the Masai Barefoot Technology (M.B.T.).

On one hand the "Stabilschuh" is qualified to treat fresh ruptures of the foot's ligaments. On the other hand the shoe can also be used in the rehabilitation process after plastic surgery of the ankle joint's ligaments. The quality of the treatment depends hereby to a very high degree on the momentarily limitation of the range of motion at the upper ankle joint (dorsal extension 10 deg and plantar flexion 40 deg) and the total prevention of any supination and pronation simultaneously. Therefore, the shoe design must include stiffening elements in the shoe's upper on the medial and lateral side and a rigid connection between upper, heel cup and shoe bottom. In our clinic the patients receive the "Stabilschuhe" three days after surgery at the ankle joint complex and wear the shoes for four to six weeks. Due to the natural material fatigue the shoe sole gets more flexible with increasing wear time. As a consequence, the stress of the initially well protected reconstructed ligaments increases gradually and leads therefore also to a smooth and physiological integration of the transplant. Between 1986 and 2002 more than 1000 patients were treated according to this procedure in our clinic. As a consequence of this therapeutical concept, the capability to go back to work as well as the capability to do sports again could be reached two to four weeks earlier compared to traditional therapies.

According to this therapeutical concept, the Achilles tendon shoe with a variable fixation device is also suitable for the postoperative rehabilitation of Achilles tendon injuries and late Achilles tendon reconstructions. The ventral rigid strap, the medially and laterally stabilizing elements and the variable heel lifts reduce at the beginning the stress of the Achilles tendon down to 20% approximately. This allows the tendon to recuperate and align its collagen structures due to a very low, but useful and functional stress. This procedure allows a partial load of the Achilles tendon in the first postoperative week already. After an Achilles tendon

reconstruction (overseen rupture) or after surgery due to a functional tendon insufficiency, the Achilles tendon shoe is used with a variable stabilization device for eight to twelve weeks. By using the variable stabilization, the force transition of the Achilles tendon is continuously increased. The progress in this rehabilitation process is accompanied and guided by biomechanical measurements. Between 1986 and 2002 more than 350 Achilles tendon reconstructions were successfully treated according to this rehabilitation pattern. Compared to traditional treatments the above described rehabilitation process lead also to an earlier integration of the patients in to their daily live, work process and sporting activity. According to the ankle joint surgery an additional night fixation is used during the first four weeks.

It is only a few years since a very special shoe design named M.B.T. (Masai Barefoot Technology) was introduced to the market. It differs from traditional shoes principally by its very soft midsole element in the rearfoot area, by a so-called roll-on ramp in the midfoot area and by increased medio-lateral instability. After some unclear statements at the beginning this device established as a work-out device for treatments after overuse injuries of the musculo-skeletal system. The application of this shoe changes the human gait dramatically and leads therefore to a changed load distribution pattern at the joints, muscles and tendons of the human body. Biomechanical studies in our house showed that the M.B.T. decreases the load at the upper ankle joint on one hand, but increases the foot's pronation on the other hand. This by the M.B.T. increased pronation movement needs to be compensated and stabilized by the foot's supinators. As a consequence, the patient needs to receive a professional instruction by an expert – as recommended by Swiss Masai - before using the M.B.T. concept as a rehabilitation device. After a correct indication the application of the M.B.T. allows therefore a very efficient training of specific muscle groups.

The authors report their results of the biomechanical and clinical studies involving the "Stabilschuh" and the M.B.T. They make suggestions about indications in which these therapeutical devices can be used and about indications in which the application of these devices might contain some risks.

## Symposium

### Exercise, Movement and Brain

S103G

S103G-1

#### Neuroendocrine response to high training load on top performance level: a single case time series analysis

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**Keywords:** triathlon, neuroendocrinology, time series

The endocrine system integrates and controls various functions of the organism by releasing or inhibiting hormones. It also works together with the nervous system to initiate and control physical activity. The response of the nervous system is characterized by a short half-life with localized effects, whereas the endocrine system reacts more slowly, having long-lasting and more general effects. Time series analysis is an appropriate method to examine time-lagged reactions of hormones to training load.

A female triathlete of international Ironman level was examined for 6 months (base line at the beginning). The following parameters were measured with different sampling rate: energy expenditure, resting heart rate and body temperature, body weight, hours of sleep; cortisol, prolactin, progesterone, testosterone, estradiol, TSH, T3, T4, leptin, renin, angiotensin, CK, urea, ammonia, subjective state of condition; performance diagnostics and nutrition analysis.

Mean energy expenditure per day was  $5245 \pm 3770$  kJ. Mean values  $\pm$  SD of the examined hormones, response to training load, time lags, and the consistency of response over the time series were analysed. Cortisol and estradiol are not significantly affected by training load. Prolactin, progesterone, testosterone and TSH increase significantly (lags 0-9 days), whereas IGF-I, T3 and T4 are negatively correlated to high energy expenditure (lags 1-11 days). While these reactions are valid for the whole time series, there are often inconsistent phases of relation. Testosterone shows a low, but significant positive response ( $r_{cc0}=.18$ ,  $r_{cc5}=.21$ ,  $r_{cc6}=.22$ ) within the complete training period while it is

negatively correlated to energy expenditure ( $r_{cc2} = -.39$ ,  $r_{cc3} = -.47$ ) in the phase of higher training load.

The results show that the response of the neuroendocrine system to training load can adopt very different time characteristics. The study also reveals that the response is rarely consistent over a long time period, as there are "windows" with very different response patterns. In conclusion, individual neuroendocrine response as a result of single case time series analysis may contribute to a better periodisation of training load.

### S103G-2

#### 5-HT reuptake inhibitor effects on performance and neuroendocrine system responses during time trials

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**Keywords:** central fatigue, serotonin

The "central fatigue hypothesis" proposed by Newsholme and coworkers (1) evolves around the exercise induced increase in serotonin (5-HT) concentrations and the onset of fatigue during prolonged exercise. Serotonin has been linked to fatigue because of its well-known effects on sleep, lethargy and drowsiness and loss of motivation (2, 3). 5-HT has been shown to increase during acute exercise (5) in running rats and to remain high at the point of fatigue (5). Several studies have tried to investigate whether oral supplementation of TRP, BCAAs precursor loading, and/or pharmacological manipulation could influence exercise performance in animals and humans (4).

Many studies in humans have investigated the potential role of 5-HT and/or DA on the outcome of performance. 5-HT reuptake inhibitors (SSRI) have been shown to decrease (6,7) or have no effect (8) on exercise performance.

We have supplemented athletes with different reuptake inhibitors (a serotonin reuptake inhibitor, a noradrenergic reuptake inhibitor a combined noradrenalin/serotonin reuptake inhibitor and a combined noradrenaline/dopamine reuptake inhibitor) in order to evaluate fatigue and performance during a 90 minute time trial. Moreover the neuroendocrine response during exercise to the different reuptake inhibitors permits a more interesting approach to the use of peripheral markers to understand central activity.

No effects on performance was observed with the different reuptake inhibitors however the different neuroendocrine response reflects a central effect of the drugs, indicating that there is more involved in the functioning of the brain during exercise than one single neurotransmitter system.

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### S103G-3

#### Neuroendocrine system alterations in female athletes: Impact of training and nutrition

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**Keywords:** menstruation, neuroendocrinology, energy balance

Physical activity might have profound effects on the integrity of the neuroendocrine system, especially on the hypothalamo-pituitary-peripheral axes. The presentation will give an overview on a series of investigations that have been performed in the research group of the presenting author in order to further investigate the possible causes for these health threatening effects. Concretely, effects of acute exercise and chronic high voluminous training alone or in combination with hypocaloric nutrition on the hypothalamo-pituitary gonadal (HPGA), thyroidal (HPTA), and adrenal (HPAA) axes have been investigated in eumenorrheic, healthy young females in a series of different studies.

The main results include: 1. Acute moderate or high intensive physical exercise has no significant effect on exogenous GnRH-induced or on spontaneous LH-secretion in either the follicular or luteal phase of the menstrual cycle. 2. 5 days of either moderate or high intensive run training has no significant effect on exogenous GnRH-induced LH-secretion, while high intensive training reduces spontaneous LH-secretion. Both studies indicate a high stability of the pituitary part of the HPGA, while the GnRH-pulse generator seems to be susceptible to highly demanding training loads. 3. 4 weeks of either high voluminous training or a hypocaloric diet do not affect exogenous GnRH-induced LH secretion. They lead, however, to a slightly reduced spontaneous LH-secretion rate or secretion amplitude. 4. 8 weeks of a combined high voluminous training regime plus a hypocaloric diet induce dramatic alterations in spontaneous LH secretion patterns, while exogenous GnRH-induced LH-Secretion even is augmented, indicating an intact pituitary part of the HPGA, while the GnRH clock is tremendously affected by the intervention. At the same time HPTA shows a low T3-syndrome as hormonal indicator for the chronic caloric deficiency.

The series of studies indicate that the main mechanism that is able to destroy menstrual cyclicity is a chronic energy deficiency that accompanies high demanding training loads. Training alone does not seem to have significant effects on the integrity of the endocrine axes. These main results are in concordance with a series of investigations from A. Loucks (1994, 2000). This author also described a disturbing effect of hypocaloric nutrition on the HPGA. Therefore, a well balanced diet seems to be a very important factor for a healthy neuroendocrine system in sports.

### S103G-4

#### Influence of the performance level on the relationship between the structure of movement representations and cortical areas in the brain

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**Keywords:** motor control, movement representation, neurophysiology

Current research demonstrates that perceptual-cognitive representations play a central role in motor control (Mechsner, et al. 2001; Schack, 2003). By using an expert-

beginner paradigm, differences in the quality of the structure and organisation of representations between experts and beginners in motor behaviour were found. Further scientific research endeavoured to define these differences concerning the central concepts and concept interrelations in network representations of special movements (Schack, 2002). In high-level experts, these representational frameworks were organised in a highly hierarchical tree-like structure, were remarkably similar between individuals, and matched well the biomechanical demands of the task. In comparison, the action representations in low level athletes and non-athletes were organised less hierarchically, were more variable between persons, and were not so well in accordance with biomechanical demands. Such research indicates furthermore that with an athlete's increasing ability to perform, also deep-reaching changes in his cognitive representation occur. For further research it was of interest,

whether such representations activate specific neuro-physiological structures. The assumption that information recall in the memory is accompanied by space and time defined changes in excitability in neuronal network structures is the basis of the neuro-physiological measurement. Studies on experts and novices in gymnastics indicated that specific basic brain areas of movement representation can be located. Hereby not only the representation but also the activated neuro-physiological structures differ between experts and novices.

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## Symposium

### From Inactivity to Activity - Intervention Concepts and Longitudinal Effects

S103H

#### S103H-1

#### The seven sequence intervention - sedentary adults on their way to fitness and health

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**Keywords:** risk factors, health directed intervention, health promotion

Comparable to most other industrialized countries, 90% of the adults in Germany do not adhere to the recommendation of the American College of Sports Medicine that "every adult should accumulate 30 minutes or more of moderate-intensity physical activity on most, preferably all, days of the week". To come closer to this recommendation, more intervention strategies which are not only health but also behavior directed are required as well as longitudinal studies to control the quality of the intervention.

Our evaluation study comprises five years starting from 1997 until 2002. Each participant of the study has been examined for three years. Within these three years data has been collected four times from the intervention group (117 sedentary adults) and the control group (40 regular physical active adults) by the means of questionnaires, motor tests and medical tests. Especially various aspects of the health status (risk factors, perceived complaints, well-being, mood, mental health, physical and psycho-social resources) and behavioral changes (adherence, coping) were recorded. The first period of the study (t1-t2) consists of "The Seven Sequence Intervention". The members of the intervention group visit one exercise session per week with a duration of 90 minutes - structured in seven sequences: 1. Preparation, 2. Warm-Up, 3. Endurance, 4. Strength & Flexibility, 5. Relaxation, 6. Stimulation, 7. Information. After the 12 months of this initial program, the participants had the chance to stay in a similar follow-up-program of the same sport-club for further 12 months or to change in other programs of this club (t2-t3). In the final year of the examination they had again the possibility to choose between the alternatives of the second period (t3-t4).

It can be shown, that the intervention reached the long term goal of a behavioral change for three quarters of the participants. Participants in a negative fitness- and health

condition before the intervention benefit to the greatest extent of the program. Other participants stabilize their status.

The results suggest the importance of a well-structured physical activity program as a bridge in non-medical therapy and the prevention especially of the metabolic syndrome.

Dunn AL, Marcus BH, Kampert LB, Garcia ME, Kohl III HW, Blair SN (1999). *JAMA*, 281 (4), 327-334

Brehm W, Sygusch R, Wagner P, Schönung A, Hahn U (2003). *Manuskript: Universität Bayreuth*

Whaley MH, Kampert JB, Kohl III HW, Blair SN (1999). *Medicine & Science in Sports & Exercise*, 31, 287-293

#### S103H-2

#### The effect of a PACE intervention in general practice on patients' level of physical activity

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**Keywords:** health promotion, general practice, effect evaluation

The prevalence of physical inactivity in the Netherlands is high: 60%. PACE (Physician-based Assessment and Counseling for Exercise) is an intervention aimed at the enhancement of regular physical activity, and is based on the transtheoretical model. The general practitioner (GP) may be a credible and thereby influential person to promote physical activity. The aim of this study is to evaluate the effectiveness of an individualised minimal intervention strategy applied by general practitioners, PACE, on patients' daily physical activity.

The study was an RCT with randomisation at GP-level. The main inclusion criteria for patients were: aged between 18 and 70 years, diagnosed with hypertension, hypercholesterolaemia and/or DM type 2, and not meeting physical activity guidelines. The intervention consisted of 2 visits with the GP and 2 booster calls by a physical activity counsellor. Prior to the visit with the GP, the patient filled out a stage-specific counselling protocol. This protocol guided the visit with the GP. Two weeks after the first visit, the patient was contacted for a stage-specific booster call, and the patient visited the GP again 2 weeks later. A second and last booster call was held 8 weeks after the second visit.

Measurements by questionnaire (stage of change, daily physical activity) were performed at baseline and at 2, 6 and 12 months. In addition, physical activity was also measured by means of accelerometers.

A total of 29 general practices participated in the study, including a total of approximately 720 study subjects. The mean age of these subjects at baseline was 56.2 years, and 55% was male. The mean number of minutes spent on at least moderate intensity physical activity was 247.2. At baseline, no differences between the intervention and control group were observed. Results on the effect on patients' level of physical activity are not available yet, but data collection on short-term results will be concluded by January 2003. Preliminary analysis of these data will be presented at the conference.

This study evaluates the effect of the PACE-program, implemented in Dutch general practice. The results of this evaluation will be discussed at the conference.

### S103H-3

#### **Determinants for increasing physical activity in the general population: The Inter99 study**

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*Keywords: physical activity, health promotion*

Increase in physical activity has been shown to reduce total cholesterol, blood pressure, waist circumference, and body mass index (BMI). Furthermore, increase in physical activity can postpone development of type 2 diabetes in persons with impaired glucose tolerance (IGT). The aim of the present study is to evaluate the effect of a population based screening and non-pharmacological intervention (physical activity and diet) on the incidence of ischaemic heart disease. Intermediate end-points are increase in physical activity, change to more prudent diet, reduction in cholesterol, blood pressure, BMI and waist circumference.

A total of 13,016 persons randomly selected from the background population were invited for a risk assessment for development of ischaemic heart disease by means of a computer program (PRECARD®). According to predefined criteria participants were classified into a high risk and low risk group. Individuals were a priori randomised to receive a low intensity intervention or a high intensity intervention. Intervention focused on increase in physical activity and change in diet. Effect was calculated as change in self reported physical activity and diet and measured BMI, blood pressure and cholesterol.

Participation rate at baseline was 52% (N=6,784). Less than 20% of the population was doing sports or other heavy leisure time activity and only half of the population fulfilled the recommendation of half an hour of physical activity daily. A total of 33% fulfilled the criteria for life-style intervention on physical activity and diet and had a health counselling talk. Nearly half accepted group based counselling during a 6 months period. Those who were physically inactive or had a high BMI, a high waist circumference or newly diagnosed type 2 diabetes or IGT more often accepted group-based health counselling than the remainder. There was no significant difference in blood pressure and cholesterol among those who accepted compared who did not accept group based counselling.

63% of the high-risk population was re-examined after one year. Data on determinant on increase in physical activity and change in other intermediate end-points will be presented.

It can be concluded that there is a major need for life-style counselling in the general Danish population.

### S103H-4

#### **"Active upon Advice" - long term effects of physical activity counselling through primary care practices**

**Martin Brian, Jimmy Gerda, Furler Dorothee, Padlina Oliver, Marti Bernard**

Federal Office of Sports, Magglingen, Switzerland

*Keywords: primary school, HEPA, counselling*

As in many other countries, the prevalence of physical inactivity is very high in Switzerland. The promotion of physical activity through primary care practices has a great potential and different approaches have been developed. The aim of the study was to develop a physical activity counselling scheme using the primary care setting in Switzerland and to assess its long-term effectiveness.

In a pilot study physical activity questionnaires based on the transtheoretical model were handed out to every patient entering one of 4 primary care offices during pre-defined time windows. All inactive individuals were entered into a randomised controlled trial. Individuals assigned to the feedback group were given feedback from their physician concerning their physical activity level. In addition, the full intervention group received further advice and stage matched leaflets and were offered a 45 minute counselling session with a specifically trained counsellor. Telephone reminders were carried out, physical activity was assessed in both groups after 6 to 8 weeks. In the subsequent effectiveness study the same procedure was carried out in 5 other primary care offices. Changes in self-reported physical activity behaviour were measured 7 weeks as well as 14 months after the intervention.

In the pilot study, complete data was available on 36 participants in the full intervention group (of which 21 followed the physicians advice and took part in the counselling session) and on 18 individuals in the feedback group. In an intention-to-treat analysis, 53% in the full intervention group and 17% in the feedback group had become active after 6 to 8 weeks. In the effectiveness study, 38% of the previously inactive individuals in the full intervention group had become active after 7 weeks, 47% after 14 months (n=55, with 42% of them taking part in the counselling session). In the feedback group, the figures were 35% and 47% (n=77).

The acceptance of the scheme was good both in patients and in physicians and their practice staff. The short term changes in self-reported physical activity were encouraging, surprisingly the long term effects were even more pronounced. However, an additional effect of the actual 45 minute counselling session could not be demonstrated in the effectiveness study. Therefore the training of the counsellors will be revised and intensified and subsequently the scheme will be launched on a larger scale.

## Oral Session

## Biomechanics 3: Muscles and Tendons

O103I

O103I-1

**Muscle properties compared to local muscle indices****Tilp Markus, Thaller Sigrid, Sust Martin**

Karl-Franzens University of Graz, Austria

*Keywords: muscle, simulation*

In sport sciences several authors (eg. Zatsiorsky (1977, 1995), Schmidtbleicher (1980)) have given useful definitions to describe the time development of maximal force. Authors created terms like e.g. "Index of explosive strength (IES)", "Force-gradient" or "Acceleration-gradient" (Zatsiorsky (1995)). All these indices depend on the conditions of the movement. We want to introduce some motion-independent quantities (i.e. invariables of motion), which we call "properties" of a muscle. With these "properties" it is possible to calculate above mentioned indices, but not vice versa.

Let's consider the sport "vertical shot putting" with the leg extensors. This movement can be described by a differential equation. The mathematical description (Sust, 1996) uses the Hill equation for the force in the muscle, an activation function  $S(t)$  to describe the innervation of the muscle and a geometric function  $G(x)$  which represents the connection between internal and external force. The parameters of the equation are on one hand the "muscle properties" (maximal possible values of force "fmax", velocity "vmax" and power "pmax", and an innervation parameter "A") and on the other hand the movement conditions like the starting position. With a measurement system at the Institute of Sport Sciences Graz it is possible to determine the individual "muscle properties" of the leg extensors with a few measurements by using nonlinear parameter estimation. This allows simulating movements under different conditions.

Leg extensions with different loads produce different force curves and therefore different indices. Extensions with 10, 20, 40 kg loads and isometric contraction (90°) result in e.g. 6929, 5589, 4261 and 2793 N/s respectively for the "IES". This shows the dependence on conditions of these values. If we determine the "muscle properties" of a person, it is possible to calculate the different force curves with one set of "muscle properties" only by changing the movement conditions. With the same method we have shown, that two subjects who produce the same isometric force curve (therefore isometric "IES"; etc.) may develop different end-velocities with different loads.

There exist two groups of indices. One depends on muscle properties as well as movement conditions and another that represents real "muscle properties". Only the second group allows to predict movements under different conditions and to calculate all indices of the first group.

O103I-2

**Muscle activity in the leg is tuned in response to impact force characteristics****Boyer Katherine, Nigg Benno**

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*Keywords: running, muscle tuning, vibrations*

Impact forces during running can be considered an input signal. They are expected to initiate vibrations of soft tissue packages which could be substantial. However, these vibrations are short in duration and small in amplitude. There is strong evidence that the muscles act to minimize vibrations in controlled quasi-static lab experiments (Wakeling et al. 2002). However, evidence for actual muscle tuning (Nigg and Wakeling, 2001) during walking and running has not been provided yet. Therefore, the purposes of this study were (a) to quantify changes in EMG activity of related muscles and (b) to quantify changes in vibrations of lower extremity soft tissue packages for differences in input signals during running.

Subjects ran in five shoe conditions at four speeds. EMG, soft tissue acceleration and ground reaction forces (incl. maximum loading rate) were measured. EMG and accelerometer signals were resolved using wavelet techniques (von Tscharner, 2000). EMG intensities were determined for the pre-activation (50ms prior to heel-strike) period. EMG and acceleration intensities were determined for the post-activation period (50ms after heel-strike).

There were no changes in the maximum loading rate when the shoe conditions were changed. The changes in muscle activity for pre- and post-heel-strike-activation were small and unsystematic between shoe conditions at a given speed. The changes in soft tissue vibration were limited and unsystematic at a given speed.

If the theory of muscle tuning holds true for running then for a change in the input signal one would expect to see changes in the muscle activation to minimize changes in the soft tissue vibration levels. In agreement with the concept of muscle tuning, for differing shoe conditions with the same input signal there was no systematic change in the EMG pre or post activation intensity of the four muscle groups tested at a given speed. Changes in the soft tissue vibration would be expected if the input signal changed or if the muscle activity changed. As the input signal and the muscle activity did not systematically change, the finding that no systematic changes in the soft tissue vibrations occurred suggests that the purpose of muscle activation prior to landing in running may be to minimize soft tissue movement.

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Nigg and Wakeling (2001). *Exerc. Sport Sci. Rev.* 29, 37-41.

von Tscharner. V. , (2000). *J Electromyog Kinesiol* 10 433-445.

## O103I-3

**Strain and elongation of the tendon and aponeurosis: Study on the gastrocnemius muscle during maximal plantar flexion effort**

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**Keywords:** *achilles tendon, ultrasonography, strain*

There are differing reports regarding the distribution of strain and elongation in tendons and aponeuroses. These may be due to methodological differences. No study was found examining in vivo the human tendon and aponeurosis simultaneously in the same trial. It should be considered that the elongation of the tendon and of the aponeurosis is an history dependent property. This study aimed to examine in vivo the elongation and strain of the tendon and aponeurosis at the gastrocnemius muscle simultaneously.

Twelve subjects performed maximal voluntary isometric plantar flexion contractions on a dynamometer. To allow the calculation of the resultant moment at the ankle joint, the kinematics of the leg, the center of pressure under the foot and the EMG-activity of the tibialis anterior were also registered. Two ultrasound probes visualised the distal and the proximal part of the distal aponeuroses of the gastrocnemius medialis. The elongation of the tendon and of the aponeurosis was analysed at 0, 15, 30, 45, 60, 80 and 100% of the maximum ankle joint moment of the corresponding trial. The differences in elongation and strain between the tendon and the aponeurosis were checked using a T-test for two dependent samples.

(a) the absolute elongation of the tendon was different to that of the aponeurosis, (b) no difference between strain of the tendon and the aponeurosis was found at any load level, (c) the ankle angle changed significantly and (d) the non-rigidity of the dynamometer arm-foot system and the antagonistic coactivity are significantly influencing the moment exerted at the ankle joint.

Joint rotation, non rigidity of the dynamometer arm-body segment system, coactivity of the antagonists, changing moment arms of tendons, creep effect and projection errors due to the 2D image analysis are methodological drawbacks for the in vivo estimation of strain of tendons and aponeuroses using ultrasound. It was tried to account for all but the projection errors. The strains of the human gastrocnemius muscle tendon and aponeurosis did not differ from each other. The elongation of the aponeurosis was significantly greater compared to the tendon and in consequence the choice of the analysed cross-point on the ultrasound image influences the estimation of the stiffness of the tendon and the aponeurosis.

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*Muramatsu, et al. (2001). J. Appl. Phys. 90, 1671-1678.*

## O103I-4

**IGF-I and IGFBP 4 in human achilles tendon tissue**

**Olesen Jens L, Heinemeier Katja, Magnusson Peter, Langberg Henning, Flyvbjerg Allan, Kjær Michael**  
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**Keywords:** *IGF-I, IGFBP 4, achilles tendon*

Accumulating evidence indicates that growth factors can regulate tendon tissue turnover and repair. It has been demonstrated that insulin-like growth factor I (IGF-I)

stimulates growth in tenocyte cell cultures and animal tendon in vivo, while IGF-1 binding protein 4 (IGFBP-4) is expressed in fibroblasts. However, to date none of them has been localized to human tendon tissue. We therefore hypothesized that IGF-I and IGFBP-4 are present in human tendon tissue and tendon growth could thereby be partially regulated by autocrine mechanisms.

We studied 6 human achilles tendons obtained from autopsies of young men (26.5±5.5 y). Tendon IGF-I content was measured by an immunofluorometric assay after homogenization and extraction in 1 M acetic acid. Immunohistochemistry was performed on 5 mm tendon slices using either antihuman IGF-I or antihuman IGFBP-4 primary antibody (R&D Systems).

Total IGF-I content in tendon was 0.53 ± 0.10 ng/g which is similar to that of resting rat muscle. Immunohistochemistry revealed a localization of both IGF-I and IGFBP-4 to tenocytes.

It therefore appears that both IGF-I and IGFBP-4 are located in and produced by tenocytes of human tendon.

*Abrahamsson SO (1996) J. Orthop. Res. 14(3): 370-6*

*Camacho-Hubner C (1992) J. Biol. Chem. 267(17): 11949-56*

*Dahlgren LA (2001) Am. J. Vet. Res. 62(10): 1557-62*

## O103I-5

**Effect of different shoe hardnesses on EMG intensity and soft tissue vibrations of the lower extremity during walking**

**Liphardt Anna-Maria, Wakeling James, Nigg Benno, Mester Joachim**

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**Keywords:** *walking, muscle tuning, tissue vibrations*

During walking the human body experiences an impact each time the heel touches the ground. This impact causes a shock wave which travels up the body and causes vibrations of the soft tissues. It has been suggested that the muscle activity is tuned in response to the loading rate of the impact of the ground reaction force in order to damp these vibrations (Nigg 1997). Muscle tuning has not been quantified during actual locomotion. Thus the purpose of this study was to determine if a change in the input frequency of the ground reaction force causes changes in the muscle activity and the soft tissue vibration of the lower extremity.

Ground reaction force, EMG intensity and soft tissue acceleration were measured.

The vertical ground reaction force showed impact related peaks within the first 50 ms after heel-strike. The effective input frequency was 35 Hz for the control condition. There was a decrease in the effective input frequency (~ 9%) for the insert condition, no changes were observed for the peak value of the impact force. The gastrocnemius lateralis and the hamstrings muscles showed increasing muscle activity for the insert condition (~ 20%). The vibration frequency for the triceps surae, quadriceps and hamstrings was between 24 and 28Hz. The peak inertial force occurred within 50ms of heel-strike. The inertial forces of the soft tissue were muscle and axis specific. For all muscles and all directions tested, the inertial loading rate and peak inertial force remained the same or showed significant decreases for the insert condition. The decreases were up to 21.7%.

The input frequency at heel-strike was greater than the resonant frequency of the soft tissue. The insert condition resulted in a lower input frequency and thus a relative frequency (input / vibration) closer to 1. This would be expected to increase the vibration if no change happens to the properties of the system. This was not the case.

Therefore, we can conclude that the mechanical properties of the soft-tissues changed in response to the shoe condition. The increased muscle activity observed for the softer condition would be expected to damp the soft-tissue vibrations. Muscle tuning seems to occur in walking and is a possible mechanism which can explain the decreased inertial forces in the soft tissues.

## O103I-6

**Stiffness and efficiency of repeated drop jumps**

**Zameziati Karim, Morin JB, Deiuri E, Telonio A, Antonutto Guglielmo, Belli A, Di Prampero PE**

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**Keywords:** *efficiency, stiffness, plyometry*

The elastic behaviour of muscle and tendons plays a major role in hopping and running. Indeed, when researchers have modelled the human motion with a spring-mass model and calculated the stiffness of the lower limbs (Belli and Bosco, 1992; Farley C and Gonzalez O, 1996; Dalleau et al., 1997) they have shown that stiffness: 1) depends on the type of movement and on the characteristics of subjects, and 2) influences the muscular efficiency of human locomotion. For instance, movements such as drop jumps, involving fast stretch shortening cycle and high stiffness of lower limbs are characterized by higher muscular efficiency than other types of jumps. The aim of this study was to precisely quantify the stiffness and efficiency during drop jumps performed on a specific ergometer in order to identify the inter-individual relationship of stiffness and efficiency.

8 subjects divided in 2 groups (explosive and non-explosive subjects). They were asked to perform repeated drop jumps

on a specific ergometer. Stiffness was defined as the slope of the best fitting linear regression between force and displacement. During the steady state, the net efficiency was computed as follows:  $NE_{tot} = (W_{positive} - negative) / (Eq(VO_2 - VO_{2rest})) \times 100$ .  $VO_2$  was also measured every 10 s, by means of a portable telemetric system.

Spearman's correlation test was used to study the relationships between the net efficiencies and the stiffness values. T-test for independent variables was used to evaluate the differences between both groups.

Net efficiency was higher in explosive subjects ( $P < 0.01$ ) while no significant differences of stiffness were found between the two groups. In addition there was no correlation ( $r^2 = 0.01$ ) between inter-individual variations of efficiency and stiffness.

Net efficiency values were in agreement with those obtained on sledge apparatus in the literature (Kyröläinen H et al., 1990) and stiffness values were comparable to those calculated during running (Dalleau, 1998). The higher efficiency obtained in explosive subjects could be explained by the ability of this type of subjects to adapt their stiffness to the mechanical requirement of 70% repeated drop jumps. However although average stiffness was 40% higher in explosive subjects large inter-individual variations of stiffness in non explosive (Mean  $\pm$  SD,  $2476.9 \pm 1236.4$  N.m-1) group and limited number of subjects did not allow us to show the possible influence of stiffness on efficiency measured during repeated drop jumps.

Belli A, Bosco C (1992) *Acta Physiol Scand* 144:401-408; Dalleau G (1998). *PhD Thesis, University of Lyon I, Lyon, France*; Farley C, Gonzalez O (1996). *J Biomechanics* 29, Vol 2: 181-186; Kyröläinen H et al. (1990). *Eur J Appl Physiol* 61: 446-45

**Oral Session****Health and Fitness 3****O103J**

## O103J-1

**Recovery of neuromuscular properties after high intensity exercise**

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University of Bourgogne, France

**Keywords:** *EMG, muscle properties, all-out run*

The purpose of this study was to compare the effects of three types of recovery on neuromuscular properties and performance after a high-intensity uphill running exercise.

The recovery interventions consisted of 20 min of (i) passive, (ii) active (50% of maximal aerobic speed), and (iii) low-frequency electromyostimulation. Evoked and voluntary contractions of knee extensor muscles and EMG of the vastus lateralis (VL) and vastus medialis (VM) were analyzed immediately after the exercise, 10 min after the end of the recovery periods (Post45) and 65min after the exercise (Post65). Eighty minutes after the end of the fatiguing exercise, the subjects performed an all-out test at 90% of maximal aerobic speed with 18% grade on the treadmill.

There were no differences between the three types of recovery for neuromuscular properties. During recovery, the maximal voluntary contraction (MVC) did not differ significantly to the post-exercise values. A tendency toward lower MVC at Post45 than at Post ( $-4 \pm 10\%$ ;  $P = 0.08$ ) was

observed. Also, a tendency to higher MVC at Post65 compared with Post45 ( $+6 \pm 5\%$ ;  $P = 0.09$ ) was noted. Nevertheless, during recovery, single twitch was characterized by an improvement of peak torque (Post45:  $+10 \pm 20\%$ ,  $P = 0.12$ ; Post65:  $+33 \pm 25\%$ ,  $P < 0.001$ ) and the amplitude of the M wave decreased for both VL and VM ( $-7$  to  $10\%$  at Post45 ;  $-11$  to  $12\%$  at Post65). A tendency to a longer all-out time was observed after EMS intervention ( $298 \pm 152$  s) than after active ( $254 \pm 117$  s;  $P = 0.13$ ) and passive interventions ( $260 \pm 106$  s;  $P = 0.11$ ).

These results indicate that the recovery of the knee extensors maximal strength after an intermittent high-intensity uphill running exercise does not depend on the type of recovery intervention tested here. A tendency toward better subsequent all-out running performance after electromyostimulation was found, but further studies are needed to confirm that this is an efficient recovery modality after high-intensity exercise. During recovery, the changes in MVC are not associated with modification of the maximal activation level. The decrease of MVC at Post45 can be linked to modifications of the M-wave, witness of the alterations of muscle excitability (West et al. 1996). At Post65, the increase in MVC would depend on the restoration of excitation-contraction coupling. It can be concluded that the kinetics of recovery of contractile properties do not necessarily follow those of maximal voluntary strength.

West et al (1996). *Pflugers Arch* 432: 43-49



## O103J-2

**Effects of two type of fatigue on VO<sub>2</sub> slow component**

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University of Bourgogne, France

**Keywords:** VO<sub>2</sub> slow component, prior exercise, fiber recruitment

During high-intensity exercises, the oxygen uptake kinetics is characterized by a slow component, which delays or prevents the attainment of the steady state. The aim of this study was to use prior fatiguing exercises to test the hypothesis that recruitment of type II fibers participates to the VO<sub>2</sub> slow component phenomenon.

Nine subjects performed three randomized all-out exercises at a work rate corresponding to 80% of their maximal aerobic power: (i) preceded by a fatiguing protocol using electromyostimulation (EMS), (ii) preceded by a fatiguing protocol using voluntary contractions (VOL) and (iii) without fatiguing protocol (CONTR). The fatiguing protocol consisted of an alternation of 10 s of isometric contractions and 10 s of recovery during 20 min, at 10% of a maximal voluntary contraction (MVC), on the two knee extensors. The respiratory gas exchanges were monitored breath-by-breath during the cycling tests and then analyzed with a bi-exponential model.

The main result is that a 20-min prior exercise with electrically-induced or voluntary contractions at a same % of MVC induce similar force reduction ( $-13.3 \pm 7.4\%$ ;  $P < 0.01$ ) but has different effects on the VO<sub>2</sub> kinetics since the amplitude registered after EMS was significantly reduced and delayed compared with those obtained in CONTR and VOL conditions ( $P < 0.05$ ). The all-out test was significantly shorter for EMS than for CONTR and VOL ( $P < 0.01$ ).

According to several studies on the recruitment order during EMS and VOL conditions, it can be considered that a fatiguing protocol using voluntary or electrically evoked contractions affects a different pool of motor units. In the present study, the fatiguing exercise in EMS or in VOL conditions induces a similar force reduction but a delayed slow component, with a smaller amplitude observed after the EMS protocol. Since an exercise preferentially fatiguing type II fibers induced a reduction of the slow component magnitude, these results cohere with the hypothesis of the progressive recruitment of type II fibers during the VO<sub>2</sub> slow component.

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Hennemann E, Olson CB (1965). *J Neurophysiol* 25: 581-598

Lexell J et al (1983). *Acta Physiol Scand* 117: 115-122  
Vanderthommen M et al (2003). *J Appl Physiol* 94: 1012-1024

## O103J-3

**Maintenance of food and physical activity changes after a weight maintenance program in obese men**

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UKK Institute for Health Promotion Research, Finland

**Keywords:** obesity, weight maintenance, diet

Both changes in diet and physical activity (PA) have been associated with improved weight maintenance (WM) after weight reduction (WR). Our purpose was to describe food

and PA patterns after a WM program and identify possible associations with diet, PA and weight changes.

The subjects were 90 middle-aged, inactive obese men (BMI 30-40, mean 33.0). After a very-low-energy diet for 2 months (mo) they were randomised into 3 WM intervention groups (walking, W; strength training, S; control) for 6 mo. Exercise groups trained 3 x 45 min/wk (W 60-70 % VO<sub>2</sub>max, S 60-80 % 1 RM). After WM there was a 23-mo unsupervised follow-up (FU). During WR and WM subjects were given dietary counselling on principles of selecting a healthy, low energy-density diet. The data on food intake is from 36 and data on PA is from 55 men who returned properly filled in records during the whole study.

In 55 men, weight decreased from 106.6 (9.7) to 91.9 (9.6) kg during WR and in the end of the last year of follow-up the mean weight was 101.3 (12.1) kg with no differences between groups at any time.

During dietary counselling (0-8 mo) increased consumption of low-fat cheese and margarine, vegetables and high-fibre bread, and decreased consumption of sugar, sausage, high-fat cheese and margarine, fat products and candies were observed. Mostly, these changes returned to pre-study consumption level and only intake of sausage and high-fat cheese remained decreased in the end of the study.

The mean energy expenditure (EE) of PA in all subjects decreased from WM to FU from 0.96 (0.50) to 0.82 (0.76) MJ/d (NS). During WM 30 % and during FU 18 % of subjects exceeded 8.4 MJ (2000 kcal) /week EE of PA. During FU walking comprised 47 % of EE of PA. Other exercise types (cycling 6 %, jogging 6 %, strength training 5 %, skiing 5 %, various other together 22 %) constituted smaller amounts of EE of PA. Other lifestyle physical activities (gardening, home activities etc.) constituted 9 % of EE of PA. 15 % of subjects in the S continued performing strength training during FU. Improved weight maintenance during follow-up was associated with jogging (15 % of subjects) and working out (11 %), but not with other exercise types or total PA. The original group assignment had no effect on PA patterns during FU.

As PA did not seem to be associated with weight maintenance during follow-up, the relapse in food intake is likely to explain the regain of weight during the follow-up.

## O103J-4

**Quality of life and physical performance of patients with Parkinson's Disease**

**Thiele Corinna, Schaar Bettina**

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**Keywords:** physical performance, quality of life, Parkinson's disease

The idea of this study is, to show correlations between quality of life and the physical performance of Parkinson patients. The individual status integrates the quality of life and allows to consider new aspects in the practical application. The knowledge about the individual status and the resources of motion open new aspects for utilizing sport as therapy.

Twenty-six Parkinson patients aged 69.89  $\pm$  6.17 - 19 males and 7 females - took part in the study. The period of time since the disease was diagnosed, amounted to 9.5  $\pm$  5.9 years. The patients were on medication since 9.5  $\pm$  6.0 years. The examination method included a questionnaire of quality of life (Medical Outcome Study Short Form SF 36; Bullinger 1998) and a physical performance test (Short Physical Performance Battery SPPB; Guralnik 1994) for the lower limbs. For statistical reasons, the Spearman Test and the T-Test were used.

The assessment of quality of life showed high deviations from the normgroup especially in the subsummary scores "physical role" and "emotional role". The investigation of SPPB presents that 3 test persons had 0-3 points, 5 were in category 2 (4-6 points), 11 patients reached 7-9 points and 7 subjects showed almost no handicap with 10-12 points. The results of the correlation of the summary scores of SF-36 and SPPB illustrate high correlations between the summary performance score and the physical summary score ( $p < 0.05$ ;  $r = 0.606$ ).

The locomotor effects of Parkinson's disease influence the estimation of physical function, physical role, vitality and the general health of the patient (Kuopio 2000). This statement is underlined by the results of the questionnaire of quality of life. The practical application demands an interdisciplinary content. The training should practice movements of active daily living (ADL) for influencing the quality of life. The improvement of motion will increase the estimation of quality of life (Kuopio 2000). The novelty for the therapy with Parkinson patients is the individualization of the resource orientation not only by physical aspects but also by quality of life.

Bullinger M, Kirchberger I (1998). Hogrefe Verlag für Psychologie

Guralnik J M et al (1994). Medical Science, Vol 49: M85-94

Kuopio A-M et al (2000). Movement Disorders, Vol 15/2: 216-223

#### O103J-5

### The influence of a long term Qigong training on CHD risk factors in adults with elevated blood pressure

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Institute of Sport Science, University of Salzburg, Austria

Keywords: CHD-risk factors, submaximal VO<sub>2</sub>, Qigong

Physical activity (western and eastern styles) has favourable effects on health and on prevention of metabolic syndrome.

The abstract is about the effects on TG, submax. mmol VO<sub>2</sub>, waist and body fat of a 52 week qigong training (N=19)(3 x 45-60min) compared to an endurance training (N=20) of adults with elevated blood pressure.

Significant rise of TG in the control group, but not in the other groups was found. No significant differences between groups in VO<sub>2</sub>, body fat or waist were detected. A significant negative correlation between VO<sub>2</sub> at 75 watt and at lactate 4 with waist was detected.

Moved forms of qigong have similar effects as low to moderate endurance training on CHD risk factors: The higher the VO<sub>2</sub> the better effects on waist and metabolic syndrome.

#### O103J-6

### Effects of an in-patient rehabilitation program in children with chronic diseases

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Keywords: physical fitness, children, rehabilitation program, chronic disease

The purpose of this study was to investigate the changes in physical fitness after a six week in-patient rehabilitation program for children with chronic diseases. In addition, the health-related quality of life and the mental health of the examined subjects were recognized.

The physical fitness was tested with the "Münchener Fitness Test" (MFT) (Rusch/Irrgang 1994), a test consisting of six exercises. The health-related quality of life was assessed using the revised German KINDL health-related quality of life questionnaire (Bullinger/Ravens-Sieberer 1999), and the subjects' mental health was examined using the "Strengths and Difficulties Questionnaire" (SDQ) (Goodman 1997).

All the children participating in this study were patients of the rehabilitation center Viktoriastift, Bad Kreuznach, Germany. Data was reported for 65 children aged 13.04±1.6 (39 m, 12±1.55; 26 f, 13±1.46). The children were suffering from chronic health conditions like obesity, psychological problems or asthma. The tests were realized at the beginning and during the last week of the rehabilitation program (Pre-/Posttest-Design), which lasted six weeks.

The children showed a significant change ( $p < 0.001$ ) in physical fitness after the in-patient program. Both, the health-related quality of life and the mental health depended on gender. The girls showed a significant decrease in mental health problems ( $p < 0.05$ ) and an increase in the overall score of health-related quality of life ( $p < 0.05$ ), whereas the boys did not show such changes.

The results of this study show that the physical fitness of children with a chronic disease can be improved during a six week in-patient rehabilitation program. This improvement may have additional benefits. The differences between boys and girls concerning the health-related quality of life and the mental health suggest that the different structure of problems relates to the different genders. Further studies concerning this aspect seem to be indicated in order to create a disease management which regards all aspects of the gender specific development in children.

Bullinger, M/ Ravens-Sieberer, U (1999): [www.kindl.org](http://www.kindl.org)

Goodman, R (1997): [www.sdqinfo.com](http://www.sdqinfo.com)

Rusch, H/ Irrgang, W (2001): [www.sportunterricht.de/mft](http://www.sportunterricht.de/mft)

## Symposium

## Gender Aspects of Exercise and Training

S104A

## S104A-1

**Effect of sex on fuel use during endurance exercise****Mittendorfer Bettina**

Washington University School of Medicine, United States

*Keywords: obesity, endurance exercise, sex*

The exercise-induced increase in energy demands is determined by the workload; the exercise intensity relative to a person's maximal aerobic capacity (VO<sub>2</sub>max), exercise duration and a person's training status determine the fuel sources used. In addition, exercise-independent factors such as a person's sex, age, and body-composition also influence substrate utilization. Women are fatter and less fit than men; this complicates the investigation of the effect of sex on substrate utilization during exercise because both increased body fat mass and aerobic fitness are associated with enhanced use of fat during exercise in persons of the same sex. Furthermore, menstrual cycle phase can affect substrate kinetics.

To determine the independent effect of sex on substrate utilization during exercise, we studied young adult men and women (during the follicular phase) who were matched by age, body-composition, and aerobic fitness (3).

The fatty acid (FA) rate of appearance (Ra) in plasma were both greater in women than in men and women oxidized more plasma free FA, presumably derived from adipose tissue TG, and less non-plasma FA, presumably derived from IMTG and possibly plasma TG, than men. Overweight and obese subjects, who were matched by age and aerobic fitness with our lean subjects, had a significantly lower increase in FA Ra in plasma during exercise but the sex differences observed in lean subjects remained. Furthermore, the relative contribution of plasma FA to total fat oxidation decreased with increasing fat mass in individuals of the same sex. Endurance exercise training increases total fat oxidation by ~25% during exercise performed at the same absolute intensity both in men (2,4) and women (1), primarily due to an increase in the oxidation of non-plasma FA, presumably IMTG (5).

We conclude that lipolysis of adipose tissue TG during moderate intensity exercise is blunted in men compared with women, independent of body-fatness; the attenuated increase in plasma FA availability in men and obese individuals leads to a reciprocal increase in the oxidation rate of FA derived from non-plasma sources, presumably IMTG and possibly plasma TG. The greater reliance on plasma FA as fuel in women than men is likely a result of greater plasma FA availability. Sexual dimorphism has to be considered when evaluating substrate kinetics during exercise.

1. *Am J Physiol Endocrinol Metab* 279: E348-55, 2000.

2. *Am J Physiol* 265: E708-14, 1993.

3. *Am J Physiol Endocrinol Metab* 283: E58-65, 2002.

4. *J Appl Physiol* 81: 2182-91, 1996.

5. *J Appl Physiol* 92: 1300-9, 2002.

## S104A-2

**Influence of menstrual cycle phase and oral contraceptive use on performance and substrate metabolism during exercise****Miller Benjamin, Casazza Gretchen, Suh Sang-Hoon, Horning Michael, Brooks George**

University of California, Berkeley, United States

*Keywords: stable isotopes, females, substrate metabolism*

In animals estrogen or progesterone acting in isolation can change lipid and carbohydrate metabolism. Therefore normal ovarian cycling or oral contraceptive (OC) administration may change energy substrate selection in females. The purposes of this report is to 1) describe changes in substrate oxidation rates due to changes in endogenous female sex hormones, 2) describe changes in energy substrate metabolism due to exogenous hormone administration, and 3) determine the influence of endogenous and exogenous female sex hormones on peak oxygen consumption (VO<sub>2</sub>peak).

Eight healthy, moderately active women were studied over 9 months. Maximal oxygen consumption was determined in both the early follicular (FP) and midluteal (LP) phases of the menstrual cycle. Women then underwent 4 isotope trials over the course of two sequential menstrual cycle phases. Studies were conducted following a small meal and consisted of 90 min of rest and 60 min of exercise at 45 and 65% VO<sub>2</sub>peak in both FP and LP. Thereafter each woman began a triphasic oral contraceptive for 4 complete cycles. The VO<sub>2</sub>peak and isotope trials were repeated during the inactive phase of the pill cycle (IP) and during the week when synthetic hormones were highest (HP). Tracer studies included stable isotopes of [6,6-2H]glucose, [1,1,2,3,3-2H]glycerol, [1-13C]bicarbonate, and [1-13C]palmitate.

With administration of OC, endogenous estradiol and progesterone concentrations were suppressed. VO<sub>2</sub>peak decreased by 13% after OC administration. There were no differences in RER at comparable absolute intensities. Glucose Ra did not change during the menstrual cycle but was significantly decreased in both phases after OC at both exercise intensities. Glycerol Ra did not change across the menstrual cycle but was significantly increased during HP at both 45 and 65% VO<sub>2</sub>peak and during IP at 65% VO<sub>2</sub>peak after OC.

Cycling of endogenous ovarian hormones has little effect on substrate partitioning. After OC administration there is an apparent decrease in VO<sub>2</sub>peak. Despite decreased VO<sub>2</sub>peak and exercise at an increased relative exercise percentage, glucose flux decreased at a given workload and glycerol flux increased while whole body substrate partitioning did not change. Therefore, endogenous and exogenous ovarian hormones differ in their effects on energy substrate partitioning.

## S104A-3

**Muscle gene expression in response to exercise and training: Are there sex-related differences?****Tunstall Rebecca**

Deakin University, Australia

*Keywords: exercise, gene expression, gender*

Substrate availability has been demonstrated to have a profound effect on modulating the expression of metabolic genes and their associated transcription factors at rest, and during exercise. Furthermore, a number of studies have demonstrated sex related differences in substrate utilisation during exercise and exercise training. There is growing evidence that the ovarian hormones, estrogen and progesterone, play important roles in regulating substrate metabolism during exercise in women. Whilst estrogen promotes lipolysis and lipid oxidation during endurance exercise, which results in a sparing of muscle glycogen, progesterone has been shown to have estrogenic antagonistic effects. However there is a paucity of data directly investigating the molecular mechanisms underlying the observed gender difference in substrate metabolism during exercise. It is becoming increasingly evident that alterations in transcription play an important role in the metabolic response to exercise and exercise training. Numerous studies have demonstrated, following a single bout of exercise, significant elevations in the transcription of genes coding for proteins involved in metabolism regulation. Furthermore, ovarian hormones induce differences in the mRNA abundance of skeletal muscle metabolic genes at rest. The available evidence showing gender differences in substrate utilisation during exercise, and hormone-induced differences in skeletal muscle gene expression, indicate a capacity for the transcription of genes to be mediating the observed gender differences in substrate utilisation during exercise and exercise training. It is unknown whether these differences would be attributable to the activation and time course of the transient increases in transcription following a single exercise bout, and in response to exercise training. Furthermore differences in mRNA stability could contribute to differences in translation efficiency and ultimately to a difference in protein synthesis rate between the sexes in response to exercise.

## S104A-4

**Collagen turnover in human tissues: The effects of age and exercise****Rennie Michael**

University of Dundee, Scotland

*Keywords: collagen, ligaments, bone, muscle tendon*

Although the cell biology of collagen in a variety of tissues is well described, we have a very poor understanding of collagen physiology in whole animals - and especially in human beings. What we infer about collagen turnover in man mostly comes from studies in animals and from the use of indirect measures of collagen synthesis and breakdown such as collagen peptides, N-telopeptides and crosslink metabolites such as deoxypyridinoline (Dpd). Unfortunately, for a variety of reasons, the tissue specificity and selectivity of these markers (together with problems related to the latency of their appearance and the duration of their existence) makes it very difficult to understand the links between physiological effectors of collagen metabolism and changes in collagen turnover and mass.

We have recently developed methods for investigating collagen turnover in any tissue which can be sampled and now have values for rates of collagen synthesis in muscle, tendon, ligament and bone – the latter not only of young healthy subjects in the fed and fasted state but also in elderly patients with osteoarthritis and in burned children.

A number of general conclusions are striking. First, collagen turns over much faster than had hitherto been generally understood. For example, a substantial portion of collagen in bone turns over as fast as myofibrillar proteins in skeletal muscle. Secondly, collagen synthesis appears to be markedly susceptible to physiological and pathophysiological alteration so that acute exercise markedly stimulates collagen synthesis in skeletal muscle and tendon in both men and women and osteoarthritis, in inflammatory disease of the musculoskeletal system, markedly increases collagen synthesis in bone. Furthermore, in patients with osteoarthritis there is no good relationship between markers of collagen synthesis (e.g. PICP, osteocalcin or bone alkaline phosphatase) measured in serum, or markers of collagen breakdown (Dpd/Crm) measured in urine.

There are some good lines of evidence suggesting that oestrogen, which apparently increases bone collagen synthesis in model systems in vitro and in animals, may inhibit collagen synthesis in ligaments and tendons, hence accounting for the increased rate of anterior cruciate ligament injury in women during the follicular phase. The effects of exercise and vibration on bone collagen synthesis are also obvious candidates as are the changes which occur in the collagen turnover in the whole of the musculoskeletal system with the menopause.

## Oral Session

## Biomechanics 4

O104B

## O104B-1

**Effects of a simulated defensive opponent on sidestep cutting biomechanics****McLean Scott, Lipfert Susanne, Van den Bogert Ton**

The Cleveland Clinic Lerner Research Institute, United States

*Keywords: sidestep cutting manoeuvre, defensive opponent, lower limb*

The purpose of this study was to compare lower limb biomechanics demonstrated by males and females during sidestepping, with and without a defensive opponent. It was hypothesized that the inclusion of a simulated defensive opponent (D) during sidestep cutting maneuvers would cause statistically significant increases in peak GRFs and peak joint rotations compared to sidestepping in an "open" lab (ND).

16 healthy subjects (8 females, 8 males) performed a series of cutting tasks under D and ND conditions (n=10). Lower limb joint kinematic data were collected using a high-speed (240 fps) motion analysis system. GRF data were recorded via forceplate (1000 Hz) and used to normalize the kinematic data to stance. Peak values of kinematic and kinetic variables commonly linked to ACL injury were extracted from the individual trial data. Analysis of variance was used to test for the main effects of sex and defense condition.

Statistically significant increases occurred in horizontal GRFs by 15-18% (medio-lateral respectively anterior-posterior) and in joint rotations up to 40% (knee valgus) when a defensive opponent was simulated. Statistical differences were also observed between male and female data across both defense conditions.

It was concluded that the simulated defense had a significant impact on resultant movement execution. Failure to include this variable in the experimental protocol will reduce the magnitude of biomechanical variables associated with knee joint loading during sidestepping and severely limit the ability to successfully identify potential mechanisms of non-contact ACL injury.

## O104B-2

**Acute effects of explosive resistance exercise on vertical jump performance****Smiliotis Ilias, Sotiropoulos Konstantinos, Christou Marios, Antonakis Manolis, Tokmakidis Savvas**

Democritus University of Thrace, Greece

*Keywords: vertical jump, resistance exercise, explosive training*

The present study examined the acute effects of loaded jump squats and semi-squats with low and moderate loads on vertical jump performance.

Ten males (age:  $23 \pm 1.8$  yr., height:  $182.5 \pm 7$  cm and body mass  $75.8 \pm 11$  kg) performed the semi-squat exercise (knee angle  $90^\circ$ ) and loaded jump squats, each one, on two separate occasions. The first time with a load 30% of the one repetition maximum (1-RM) in the semi-squat and the second with a load 60% of 1-RM. On each occasion 3 sets of 5 repetitions with 3 minutes of rest were performed as explosively as possible. Vertical jump performance was

measured with the squat jump and the countermovement jump before exercise, one minute after each set and at the 5th and the 10th minute of recovery. The height of the jumps was calculated from the flight time of the jumps that were performed on a force resistive platform connected to a digital timer (Ergojump, Psion XP, MA.GI.CA. Rome, Italy).

Countermovement jump increased ( $p < 0.05$ ) by 1.69 cm (4%) after the 1st and the 2nd set compared to pre-exercise values when loaded jump squats were performed with a load 30% of 1-RM, and by 1.73 cm (3.3%) after the 2nd and the 3rd set when a load 60% of 1-RM was used. When semi-squat was executed, countermovement jump increased ( $p < 0.05$ ) by 1.67 cm (3.3%) after the 1st, the 2nd set compared to pre-exercise values only when a load 60% of 1-RM was used. The only difference observed among the protocols was that countermovement jump was higher ( $p < 0.05$ ) after the semi-squat than the loaded jump squats only after the 1st set when a load 60% of 1-RM was applied. Squat jump increased ( $p < 0.05$ ) by 1.74 (4.9%) after the 1st set compared to pre-exercise values when semi-squat was performed with a load 60% of 1-RM. No differences ( $p > 0.05$ ) were observed among the protocols in squat jump performance.

The above data show that explosive resistance exercise can cause acute increases in countermovement jump performance. The load used does not seem to differentiate the effect of loaded jump squats while at least a moderate load should be used when the "classic" form of dynamic semi-squat exercise is performed. Differences in neural activation patterns and the elastic properties activated in each form of jump and training method may explain the different effects of each training method on the two forms of jumps.

Young et al. 1998. *J. Strength Cond. Res.* 12(2): 82-84, 1998.

Wilson et al. 1993. *Med. Sci. Sports Exerc.* 25(11): 1279-1286, 1993.

## O104B-3

**Pre-season concurrent strength and endurance development in elite soccer players****Helgerud Jan, Kemi Ole J, Hoff J**

Norwegian University of Science and Technology, Norway

*Keywords: soccer, maximal force, maximal lactate steady state*

The aim of this study was to intervene in an elite soccer team using concurrent high intensity long interval training and maximal strength training. The hypothesis was that the responses from each intervention would be found to a similar degree as if the strength or the endurance intervention took place alone.

Twenty-one elite soccer players from Molde FC, Norway, having recently participated in European Champions League took part in the study. During an eight-week intervention VO<sub>2</sub>max increased from 60.5 (SD=4.8) to 65.7 (SD=5.2) mLxkg<sup>-1</sup>xmin<sup>-1</sup>, and half squats one repetition maximum increased from 115.7 (SD=23.1) to 176.4 (SD=18.2) kg. The running economy improved by 3.5%, 10m sprint improved by 0.06 sec or close to half a meter, and vertical jumping height increased significantly by 3 cm.

There seem to be no negative effects from carrying out concurrent high intensity aerobic training and maximal strength training. Both maximal strength and high intensity long interval training should be included in pre-season training for top-level soccer players to increase performance level.

#### O104B-4

### Values for maximum strength of ice hockey players in relation to untrained subjects

**Marchart Petra, Haber Paul**

Institute of Sports Sciences, Austria

*Keywords: ice hockey, strength values*

Ice hockey is known as the fastest game in the world played on two feet. Not only to exert intense bouts but also to success in rough body fights the training of maximum strength and its maintenance during the season is compulsory. This study should present values for maximum strength of professional ice hockey players in relation to untrained subjects of the same age, body weight and body size. Furthermore strength data obtained at the beginning, during and at the end of off-ice preparation should show the importance of a continuous and consequent build up of maximum strength.

20 professional ice hockey players from the Austrian National League participated in strength tests at the end of off-ice preparation. A part of the team participated in three strength tests during off-ice preparation. Maximum strength (One-Repetition-Maximum, 1-RPM) was measured on a dynamometer (Concept 2 dynoÖ) for three exercises: seated bench press, leg press and seated bench pull. Maximum strength for bench press with free weights was also quantified.

Strength values obtained from the dynamometer present a mean bench press performance of 142 %, a mean leg press performance of 162 % and a mean bench pull performance of 133 % of the average in relation to age and body surface. Maximum strength tested at the beginning of off-ice preparation showed values of 124 - 131 %. At the end 134 to 158 % were performed.

This study presents a minimum level for maximum strength of professional ice hockey players in percent of the average in relation to age and body surface. We suggest that an ice hockey player should have a minimum of 140 % for bench press and bench pull and 160 % for leg press compared to an average person of the same age, body size and body weight. In addition, we underline the importance of a continuous build up of maximum strength before the on-ice preparation and its maintenance throughout the season.

Cox MH et al (1995). *Sports Med* 19 (3): 184-201

Montgomery DL (1988). *Sports Med* 5: 99-126

#### O104B-5

### Multidimensional performance characteristics in talented youth field hockey players - a longitudinal study

**Elferink-Gemser Marije, Visscher Chris, Lemmink Koen**

Institute of Human Movement Sciences, The Netherlands

*Keywords: field hockey, youth, talent, multidimensional performance characteristics*

To reveal performance characteristics of future elite field hockey players, a group of 41 talented youth female field hockey players, all playing at the highest competition level for

their age category in the Netherlands, is followed over time. So far, two measurements (t1 and t2) have taken place with a time-interval of one year. Within the pool of talented athletes (mean age at t2 = 15.89 ± 1.39 years), a comparison has been made between 16 youth top players and 25 youth sub top players in terms of anthropometric, physiological, technical, tactical and psychological characteristics. The distinction between youth top and sub top players was based on the performance level of the players at t2: players who played additional to a club selection team in a district or national selection team were considered to be youth top players whereas players who only played in a club selection team were considered to be youth sub top players.

Using a MANCOVA with age as a covariate, results show that on t1 as well as on t2 youth top players scored better than youth sub top players on tactical and psychological characteristics. In a Repeated Measures Analysis, the development in one year of most of the multidimensional performance characteristics appeared comparable for both youth top and youth sub top players. Overall, length, body mass and percentage body fat increased; peak shuttle sprint performance (30m), repeated shuttle sprint performance (3x30m) and peak shuttle dribble performance (30m) improved. No differences in scores on t1 and t2 have been found for tactical or psychological characteristics. The development of the interval endurance capacity was not comparable for youth top and sub top players. Youth top players improved themselves in one year whereas youth sub top players scored worse on t2 than on t1.

In conclusion, all talented youth female field hockey players have well developed multidimensional performance characteristics. However, when differences between youth top and sub top players are considered, especially tactical and psychological characteristics seem to make a difference favouring the youth top players. Thereby, the development of the interval endurance capacity in one year also seems to play a role.

#### O104B-6

### Maximal velocity and biceps femoris muscle contraction time dependence - tensiomyographic analysis in elite sprinters

**Valencic Vojko, Djordjevic Srdjan**

Faculty of Electrical Engineering, University of Ljubljana, Slovenia

*Keywords: m. biceps femoris, tensiomyography*

The biceps femoris is one of the hamstrings muscles injured frequently during sporting activities. The most common cause of sports injuries appears to be in the running section of athletics (Palastanga et al., 1989). In elite sportsmen the morphological and functional muscle characteristics are a combination of their inherited and cumulative changes due to a training process. Our main objective was to determine the influence of sprinters' specific training on m. biceps femoris (BF) biomechanical properties and to try to estimate the importance of m. BF in maximum sprinting.

For non-invasive determination of m. BF contractile properties tensiomyographic (TMG) technique was applied. TMG enables selective, non-invasive and simple assessments of various biomechanical relevant parameters of human skeletal muscles (Valencic, 1997). Responses of m. BF on the right side of the body were measured and compared in two groups: first group: 15 elite male sprinters (23.2 ± 3.1 yrs), second group: 15 sedentary male subjects (24.5 ± 5.1 yrs) - who all volunteered for the investigation. Sprinters completed a 20-m maximal velocity test (flying

start). M.BF properties analysis was based on TMG using parameter contraction time (between 10% and 90% of the maximum muscle twitch response). With the proposed method one can measure response of a single muscle within a given muscle group more selectively than with any other known measurement techniques.

For the sprinters group m. BF parameter Tc was significantly shorter in comparison with the twitch contraction time for sedentary young men, which indicates significant differences between subjects of the first and second group. In the group of 15 sprinters a significant linear correlation ( $r = 0.72$ ,  $p < 0.01$ ) between parameter Tc and sprint velocity (on 20 m flying) was calculated.

The differences between sprinters and sedentary subjects support our hypothesis about the plasticity of the biceps femoris muscle. Results show significant correlation between maximal velocity and biceps femoris contraction time obtained by TMG. These findings will contribute to a better understanding of the importance of biceps femoris importance in maximal sprinting.

Palastanga N et al. (1989). Anatomy and human movement. p331-335. Valencic V and Knez N (1997). Artificial Organs 21(3): 240-242.

#### O104B-7

### Tracking of physical fitness: a 25-year follow-up study from adolescence to adulthood

Mikkelsson Lasse, Kaprio Jaakko, Kautiainen Hannu, Kujala Urho, Nupponen Heimo  
Pajulahti Sports Center, Finland

*Keywords: physical fitness, tracking, fitness tests*

The aim of the study was to investigate relationships between physical fitness in adolescence and adulthood.

From a population sample ( $n=890$ ) of 40 yr old subjects, who had undertaken the Test of Physical Fitness for Schools in 1976, 575 returned a questionnaire in 2001. We then selected 129 subjects with either the best results or the worst results in 1976 on the endurance test. Altogether 64 subjects (29 men) participated in physical fitness assessments at the Pajulahti Sports Institute. The index of measured physical fitness in adolescence was formed by summing up the z-scores of distance running (2000m boys and 1500m girls), 50 m run, pull-ups (boys) or flexed arm hang (girls), shuttle run, a 30-second sit-up test, standing broad jump, hand-grip test and sit-and reach test. The index of measured physical fitness in adulthood was formed by summing up the z-scores of aerobic capacity (12-minute bicycle ergometer test), ergo-jump tests (countermovement jump and jumping in 15 seconds), a 30-second sit-up test, handgrip test and sit-and reach test.

Spearman correlations between the indices of measured physical fitness in adolescence and in adulthood were 0.54 for men and 0.45 for women. Correlations between exactly similar tests in 1976 and 2001 for men and women were the following: 0.66 and 0.42 in sit-and-reach tests, 0.58 and 0.21 in sit-up tests, 0.54 and 0.38 in hand-grip tests. We used locally weighted scatter plot smoothing (Lowess) to describe the relationship of different physical fitness test in adolescence and adulthood. Subjects with the best endurance results in adolescence are shown as black dots and worst results as open circles.

Tracking of physical fitness from adolescence to adulthood was moderate and consistently lower in women than in men.

## Oral Session

### Physical Education and Pedagogics 1

O104C

#### O104C-1

### Improving physical education: issues of volume and quality

Johns David, Wong Stephen, Ha Amy, Morris John, Ma Ada

Chinese University of Hong Kong, China

*Keywords: intensity, health-related physical activity, frequency*

This study compared a normal physical education program (NPE) and an enhanced physical education program (EPE) during a school year using peak oxygen uptake, body composition, flexibility, muscular strength, and upper body muscle endurance as criterion measures.

Twenty seven male and female participants were tested at approximately 3-month intervals beginning with an initial testing to establish baseline score. Participants and the physical education programmes were monitored using a modified academic learning time in physical education (ALT-PE) instrument, a self-reported activitygram and the Tanner sexual maturity scale.

No significant difference was found between NPE and EPE participants when a two-way repeated measures multivariate analyses of variance was conducted to compare the fitness scores.

It was concluded that an EPE program was not more effective in improving students' fitness when compared to a NPE over a school year demonstrating that more time spent in physical education does not necessarily result in the improvement of cardio-respiratory fitness. Moreover, the study supports the principle that physical fitness depends not only on the duration and frequency of activity but also on the quality of the activities being conducted.

#### O104C-2

### Social learning in Physical Education: A developmental approach

Pühse Uwe, Gerber Markus

Institute of Exercise and Sport Sciences, Switzerland

*Keywords: age, social learning, practical examples*

The development of social competence is one of the most important areas in the process of socialization. From this idea arises the question how sport can contribute to the socialization of participants. According to our framework and evaluation (Pühse/Gerber 2002), physical activity seems to be particularly beneficial when it takes place in an educational environment and when it includes social learning.

Therefore, numerous researchers have developed models dealing with social and cooperative learning during the last two decades. These concepts all include interesting and well-founded advice for the realization of social learning in sport and physical education. On the other hand, they are all rather general than age specific. For that reason, developmental aspects of social learning are often not taken into consideration even though they have been defined as far as possible in the body of literature.

The objectives of this project were twofold: First, sport specific social learning targets had to be defined for each age-group from 4 to 18 years. Secondly, practical examples for each developmental level and the various social learning targets had to be developed in order to create a help for PE teachers to implement social learning. Founded on the work of Piaget, Kohlberg and Selman we distinguish between five developmental levels.

However, the developmental levels are not conceptualized as rigid categories that simply attribute specific skills to certain age groups. They should rather be considered as an orientation for the creation of the practical examples and the implementation of social learning considering age-specific characteristics of the students.

*Pühse, U./Gerber, M. (2002; submitted): Effects of physical activity on social behaviour and self-concept – A meta-analytic study. In: AIESEP Proceedings: International Congress La Coruña 2002.*

#### O104C-3

### The reliability of rating teaching skill in the selection of physical education students

**Varstala Väinö, Sääkslahti Arja**

University of Jyväskylä, Finland

*Keywords: teaching skills, rating*

The purpose of this paper is to study the reliability of rating teaching skill in the selection of new students to the Faculty of Sport and Health Sciences in the years 2001 and 2002. The selection procedure includes an examination on professional literature, motor skill tests in different sports, a micro-teaching test, and a voluntary music test.

The data in this study was from the entrance examinations in the years 2001 and 2002. There were altogether 43 male students who were not admitted entrance in 2001 and who took part in the entrance examination also in the year 2002. This study focuses only on the micro-teaching test. In this test, the applicants had to teach a given task in 5 minutes. The time for planning the teaching was 10 minutes. Two members (the authors of this paper) from the faculty staff rated the applicants teaching skill using four criteria: 1) general teaching behaviour, 2) organizing and explaining the task, 3) giving feedback and interpersonal relations with the students, and 4) development of the given task. In each criterion both raters gave independent evaluations on the scale 1-5 (poor - excellent). The maximum was 40 points (2 x 20).

The results showed, that the inter-rater reliability of teaching skill (the sum of the four criteria) was high,  $r=.95$  in the year 2001, and  $r=.87$  in the year 2002. In the final paper the rating reliability and the stability of the applicants' teaching behaviour from the year 2001 to 2002 will be analyzed in more detail.

#### O104C-4

### How does the concept of physical literacy affect what is and might be the practice of physical education

**Haydn-Davies Dominic**

Leedon Lower School, Bedfordshire, United Kingdom

*Keywords: physical education, teaching, physical literacy, learning*

The title of this paper is taken from a series of questions posed in Margaret Whiteheads' paper 'Physical literacy - Opening the Debate' (2001). This paper offers the findings of a school-based investigation carried out as part of a Department for Education and Skills Best Practice Research Scholarship. Physical Literacy is based on philosophical ideas, which can prove difficult to manifest in a practical situation, such as education. The initial process involved in this research aimed to develop a practical understanding of the concept of physical literacy. The aims encourage the development of how this concept can be utilised to offer high level outcomes from physical education, as well as how current practice can support the development of physical literacy. The aims, as pertaining to the practice of teaching and learning in Physical Education, were to investigate a framework for teaching the skills needed by a physically literate child.

This was supported by developing a series of learning strategies for children to use in and outside curriculum time.

The intended outcomes for children are shown in Whiteheads' preliminary definition of a physically literate individual: moves with poise, economy and confidence in a wide variety of physically challenging situations. Furthermore the individual is perceptive in 'reading' all aspects of the physical environment, anticipating movement needs or possibilities and responding appropriately to these, with intelligence and imagination.

The implications of this research encompass all areas of physical learning, from both the child's and the teacher's perspectives. Teacher training, both in-service and initial training, can offer the educators an understanding of the concept, which in this research has raised awareness of perceptions towards teaching and learning in PE as well as attitudes towards learning in this subject. Learning opportunities have focused on developmentally appropriate concepts and skills building towards a generic skill base that can be applied intelligently, efficiently and effectively into many differing activity contexts. The development of language, observation and evaluation skills by young children are intended to prepare them to take a more active part in their own physical learning, promoting physical literacy and lifelong physical activity.

*Whitehead M. (2001). The European Journal of Physical Education 6, 127-138*

#### O104C-5

### Fairness education in physical education

**Heim Christopher, Battenberg Susanne, Frick Ulrich**

Johann Wolfgang Goethe University, Germany

*Keywords: physical education, handball, fairness*

Research points to the importance of Physical Education (PE) incorporating issues relating to fairness and fair play. However, until now no empirically validated research as to the effects of fairness education on pupils' behaviour has been reported. The aim of this study was therefore to compare the effectiveness of direct (explicit) fairness



education with incidental (implicit) learning of fairness during routine PE lessons in which fairness is not explicitly discussed as a topic, focusing on 1) changes in pupils' attitudes to fairness and 2) pupils' fairness behaviour following a six week teaching unit.

A six-week longitudinal study was conducted with two seventh grade classes (age-range 12-13 years) consisting of 24 and 25 pupils respectively. In one class, the learning process was deliberately influenced by confronting the pupils with situations necessitating the need to deliberate on the issue of fairness (fairness education class, FEC); in the other class the topic fairness was not explicitly discussed (physical education class, PEC). Pupils' attitude towards fairness as well as their fairness behaviour was measured in both classes prior to the six week teaching period, and thereafter with 1) video analysis of pupils' behaviour during a handball tournament and 2) a questionnaire developed in order to quantify pupils' attitudes towards fairness.

Video analysis of the two tournaments showed an improvement in fairness behaviour in FEC, whereas hardly any change could be registered in PEC. Similar results were achieved concerning pupils' attitudes towards fairness. Here, significant improvements were registered for all categories in FEC, whereas there was a slight improvement in only one category in PEC.

Results indicate that both pupils' attitudes towards fairness and their fairness behaviour can be improved as a result of direct fairness education, whereas incidental learning of fairness in "normal" PE lessons does not seem to lead to either an improvement in pupils' attitudes towards fairness, or to an improvement in fairness behaviour. The results therefore lend support to the notion that PE lessons can benefit from explicit fairness education. It is concluded that education toward fairness should form a compulsory part of physical education.

#### O104C-6

### Governing physical education: power, knowledge and subjectivity in PE

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*Keywords: physical education, government, subjectivity*

The paper discusses Physical Education (PE) in Swedish primary and secondary school in relation to the question of government. This concerns the government of PE as well as PE's role in the shaping of governmentalities, i.e., the linking of the serial histories of the practices of the self with those of the practices of government.

The methodological approach is generalological, i.e., that several parallel histories shape PE and the ways in which objects and subjects of knowledge, power, moral etc. in PE are performed.

The parallel histories that form the subject of PE, concerns national curricula and subject syllabi, teacher education, the tradition of Swedish gymnastics, the Sports movement (competitive sport), public health planning and promoting, and behavioural and social research in sport.

During the last century, the successive changes of the name of the subject in the Swedish national curriculum mirrors changes in governmental strategies: Gymnastics; Gymnastics with play and sport (1919); Sport (1981); Sport and Health (1994). The subject of PE seem to move from a praxis oriented subject to a reflexion oriented subject, both

as far as teachers and pupils are concerned. Pupils and teachers are constructed as active, reflexive, flexible and meaning seeking moral subjects. My contention is that we regard these changes as expressions of changes in strategies of government, both as far as the subject of PE is concerned and its role as a performer of subjectivity, i.e., changes from social liberal (centralised and objectifying) to neoliberal (decentralised and subjectifying) governmentalities. The subject of PE is caught up in the endeavour to fashion healthy self-regulating subjects in a society where public health services are dismantled. Due to this, health becomes a personal project, and connotes not only well-being, but also success in labour, leisure and love.

#### O104C-7

### Predictors of physical activity intention and intrinsic motivation among schoolchildren: A structural modelling

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*Keywords: physical activity, intention, intrinsic motivation*

In teaching-learning processes cognitive variables, such as student's reports of their attention, use of strategies, and motivational levels, impact measures of student engagement, student effort, and achievement in physical education classes have been established (Solmon and Lee, 1997). In this study it was hypothesized that these cognitive variables and also the perception of learning orientation may influence on students' physical activity intention after school graduation.

The participants in this study were 486 students at age of 12-18 years. Student's cognitive processes: self-regulation, confidence-efficacy, willingness to engage, strategies were assessed using the CPQPE (Solmon and Lee, 1997). Learning orientation was assessed by learning orientation subscales (Papaioannau, 1994). Also, the ability subscale (Duda and Nicholls, 1992) to measure the students' beliefs was used. The intrinsic motivation was measured by three subscales of SMS (Pelletier et al, 1995). Four items were designed to measure the physical activity intention. A structural model was developed by LISREL 8.51.

The developed model demonstrated adequate fit with the data. From the observed dimensions the perceived ability as cause of the success, willingness to engage and confidence-efficacy had direct effect on students' physical activity intention. However, indirect effects of these dimensions on intention were also mediated via the intrinsic motivation. Self-regulation, use of strategies and learning orientation were strong predictors of intrinsic motivation and influenced by it on intention.

The cognitive variables involved into the model accounted for 42% of the variance in intentions. Similar results were also obtained by the investigations where the influence of others cognitive variable such as the attitude, self-efficacy and past behaviour on intention was examined. The effect of the most observed cognitive variable on intention was mediated by the intrinsic motivation.

*Pelletier L.G et al (1995). J Sport Exerc Psychol 17: 35-53*  
*Solmon M.A, Lee A.M. (1997). Res Q Exerc Sport 2: 152-160*  
*Duda J, Nicholls J (1992). J Educ Psychol Vol 84: 290-9*  
*Papaioannau A (1994). Res Q Exerc Sport 1: 11-2*

## Symposium

### E-Learning and Information Asset Management: Converging Technologies for Research and Education

S104D

#### S104D-1

#### E-learning in sport science: The experience of the "virtual campus of sport"

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National Institute of Physical Education of Catalunya, Spain

*Keywords: e-learning, virtual campus, blended learning*

The "Virtual Campus of Sport" (<http://www.deporte.uvvirtual.com>) is the on-line learning programme developed by INEF-Catalunya (Universitat de Barcelona / Universitat de Lleida) in cooperation with UB Virtual (Universitat de Barcelona Virtual). The aim of this presentation is to describe our experience as providers of postgraduate on-line courses in the field of Sport Science.

In the academic year 2000-2001, INEFC started its e-learning programme, with two specialising courses. During the next two years, this number of courses has been increased and nowadays we offer more than 12 different courses related to several knowledge areas in the field of Sport Science. Course materials are presented to the students in different ways, depending on the educational aims and the specificity of the subject matter: text (pdf or html format), images, graphics, videos, sounds, multimedia animations, etc. During the course, students have to carry out several learning activities pursuing a double aim: to allow the students to consolidate their learning and to permit the teachers to evaluate the knowledge acquired by students. The virtual learning environment, in which our courses are implemented, includes several communication tools that allow the communication among all the course participants, at individual or group level (tutor-student/s, student-classmates). We tend to use formative and continuous assessment in our courses. Tutors evaluate the activities that students execute and send a feed-back to them. In some cases, we also use co-evaluation: tutors ask students to send their activities to the open discussion forum, with the intention that other students can give their opinion and feedback too.

After these three year experience as e-learning providers, we consider that e-learning is feasible in different areas of the field of Sport Science. However, it is observable that more research is needed to improve the quality of the courses: How students approach e-learning? How they organise their own learning process? What do they think about the contents, the activities and the learning methodology implemented? The answer to these questions is the clue for achieving the full effectiveness of e-learning courses.

#### S104D-2

#### Intellectual capital and rights in electronic information asset management

**Wigger Ulrike**

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*Keywords: information asset management, intellectual capital, electronic rights*

Today, members and students of any university produce an ever-increasing wealth of data, information, research results,

literature, and scientifically validated knowledge. In the area of sports informatics, new models and procedures for visual representations and large amounts of simulation models are continuously being developed. Modern information technologies offer ways to organize and structure differentiated access to and dissemination of such intellectual assets.

The Information and Communication Center at the German Sport University Cologne in cooperation with IBM is in the process of implementing two key technologies for intellectual asset and rights management: the IBM Content Manager (CM) and the IBM Electronic Media Management System (EMMS). The CM is an enterprise-scalable repository for virtually any type of digital content, including HTML and XML web content, document images, electronic office documents, and rich media such as digital audio and video. The IBM EMMS is a suite of enabling tools for digital distribution of rich media content, including security, rights management, reporting, and payment interfacing.

Business enterprises have long made profits by capturing their innovative potential early, planning their patents, mining them for value, and mapping strategies for the transformation of intellectual assets into capital (Davis&Harrison, 2001). The combination of electronic content and rights management technologies enables the creation of new business models and information paradigms, also for enterprises such as universities. It allows for flexible digital rights management and group-based differentiated access to information assets. The decision, however, which assets to share broadly and which to hold on to for sales, patent protection or licensing lies within the institution and/or the intellectual property owner.

*Davis JL and Harrison SS (2001). Edison in the Boardroom: How Leading Companies Realize Value from Their Intellectual Assets.*

#### S104D-3

#### An e-learning based education and certification concept for the ECSS and its economic potentials

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German Sport University Cologne, Germany

*Keywords: education, e-learning, economy*

New software products and rapid improvements of the medium Internet opened a wide range of opportunities for global organisations to reorganise their internal education systems and for new companies to offer commercial e-learning solutions. Only for the US economy a volume of \$23 billion is expected for 2004 for this branch. These developments create great opportunities for the European College of Sport Science to implement an e-learning based certification programme and to profit from these economic potentials.

Based on the concept of the 4-Tier Model of Blended Learning® and on the already existing products offered by established e-learning institutions like Sport-eL, such a concept can be developed: on the Information Level, learning is based on simple solutions like Web Lectures. On the

Interaction Level, more complex products like CBTs are used. On the Collaboration Level, internet based same-time sessions are utilized to teach and discuss specific topics. The face-to-face learning on the Collocation Level finally completes the system. Not only because of the convenience in use of these teaching materials but also as they are easily stored, customized and distributed, these information assets have an economic surplus and a significant market potential. In combination with the image of the ECSS and the potential market for ECSS-proved education material an additional scenario with massive economical and image-improving potentials emerges. Only in Germany e.g., 700,000 people are working as physiotherapists, 24 million people are doing club sports and 5.6 million people are members in gyms. It is obvious that even a small market covering among those would create significant turnovers. Based on its core competences as a content creator with a significant image among the potential target groups, it will be easy for the ECSS and its potential partners to serve the whole value chain up to the customer.

## S104D-4

**IBM Global Campus - employee development: E-Learning**

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IBM Austria, Austria

*Keywords: e-learning, skill management*

IBM Global Campus is IBM's internal education portal. It offers all 325.000 IBM employees access to thousands of classroom and e-learning courses and offerings. Every employee can search the entire catalogue and enrol for his or her needed course. By offerings this platform the IBM Global Campus serves as an important part of the Skill Development and Employee Development at IBM.

The IBM Employee Development Cycle was introduced to ensure that employees and their managers have the required skills and competencies to meet the needs of a constantly changing marketplace and environment by having ongoing career discussions.

The Employee Development Cycle links PBC (Personal Business Commitment = appraisal) objectives with assessments of Skills/Competencies, and the Individual Development Plan to form a complete cycle that aligns the employees responsibilities with IBM business strategy and objectives.

The Employee Development Cycle engages every employee in the process of how the employee will achieve business results by developing the right skills, and provides feedback to his or her your progress.

**Oral Session****Communication****O104E**

## O104E-1

**Quality management in organized youth sports**

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*Keywords: quality management, youth sport, unpaid leadership*

In the organized youth sports, a discussion about quality management is going on. The paper deals with the central question: How should a quality management concept look like in unsalaried organized youth sports? The answer will be approached in two steps. At first, the lecture presents a quality management concept which is oriented at the model of the European Foundation for Quality Management (EFQM) and its transfer to human services (Merchel, 2001). The concept considers in particular the special conditions of sports clubs, in which the representatives of leadership as well as coaches are unpaid persons. Results of a pilot project for quality management in unpaid youth sports will be reported in the second part.

A qualitative analysis has been carried out to analyze how the quality criteria have been planned and realized on the level of structure, process and results and how these were assessed. Five representatives of leadership and four coaches of the youth soccer division have been investigated with problem orientated interviews.

The following results show a general concordance of the quality management concepts in theory and practice. The representatives of leadership and the coaches accept the practical concept on the whole, but also several problems do

appear. Quality of structure: Mainly, the concordance with the theoretical concept is in the area of leadership and coaches. Quality of process: In concordance with the theoretical model, agreements exist for most of the key processes (training and organization). Only some of the representatives of leadership realize these agreements, but others work almost exclusively with own methods. Quality of results: The key performance result "training and competition" has been determined in concordance with the theoretical concept. But only some of the coaches can name the defined key performance results concretely.

In several quality criteria, the model of the investigated sports club corresponds with the theoretical concept. But obvious barriers for the representatives of leadership and the coaches can be seen in view to the system of the quality management concept. The main problem of quality management in the investigated sports club is the realization of agreements. This concerns representatives of leadership as well as coaches. Here, a deficit of the theoretical concept can be seen.

*Merchel J (2001). Qualitätsmanagement in der Sozialen Arbeit*

## O104E-2

**The Sport's City program: Making policy for 'sport for all' in Norwegian cities**

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*Keywords: sport policy*

The Sport's City Program (SCP) developed following the delivery of the first official report to the Parliament on sport (St.m. nr. 41 1991-1992). It is a governmentally initiated attempt to organise sport and physical activity so that they become more accessible for the inactive segments of the population. The SCP is implemented by The Norwegian Olympic Committee and Confederation of Sports (NOCCS), and is annually funded by the government. The national administrator distributes the money to the consultants in the district sport associations. The district consultants distribute the money to the sport clubs according to criteria defined by the Ministry of Cultural and Church Affairs' Sport Department (SD).

During the work with the first official report on sport (1991), the cities were considered a special challenge when it came to sport participation. However, in some cities programs were already developing. The report holds that the SD is positive to these programs, and will support them financially. The SD proposes some cooperation between local sport organisations and municipalities, and suggests NOCCS to have a coordinating role. The government views certain groups as falling outside NOCCS's existing sport supply. In the last official report on sport, the criticism of ordinary sport is even more explicit. The achievement focus and competitive orientation of NOCCS' culture are held as constraints for developing 'sport for all'.

The established understanding of NOCCS's autonomy and its 'nature-given' capabilities to be the executer of sport for all is disturbed. This disturbance is emphasised by the fact that SD communicated directly with the district units of NOCCS, instead of via NOCCS's central staff, the first years of the program's existence. The latest years, however, there has been a process of centralisation, which includes that the 'coordinating role' now is moved from the biggest district unit to the central staff.

SCP follows trends where the relationship between the state and voluntary organisations builds upon goal steering and achievement reports. The SCP may be considered a 'contracting out' relationship. It can also be considered as mistrust since the NOCCS has not fulfilled 'sport for all'. The development the latest years, with centralisation processes make it seem, however, like the faith is re-established, following the rules of rationalised myths.

## O104E-3

**Sport as an agent of integration in Malaysian society**

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*Keywords: social integration, cooperativeness, racial harmony*

Malaysia is a multiracial country having three main races namely, Malay, Chinese and Indian. Each of these races practices a different religion, customs, rituals, language and belief system. During the colonial occupation and even immediately after Malaysia gained its independence in 1957, there was segregation of the 3 main races with each race

dominating only certain areas of Malaya; the Chinese congregated around the town areas specifically controlling the tin-mines industry, the Malays were seen mostly in the paddy plantation industry while the Indians dominating the rubber plantation industry. These differences are not only seen in their choice of occupation and living areas but even to the extent of their choice of sporting activities. With such differences and diversity in beliefs and practices one would think that it would be difficult for these different races to work together as a team. However, with the introduction of the Malaysian Sport Policy, the different races were able to work together as one big family. This paper will discuss how the elements of sport are able to bring together these three main races to work together as one team and be proud as a nation. The introduction of the Malaysian Sport Policy after the racial riot in May 1969 has successfully installed among the different races elements such as society togetherness, multiracial cooperation and tolerance, friendship and most importantly loyalty to the nation through sport and physical education. Sport is seen not only as a competition but it also acts as a catalyst integrating these three main races of different societal values. The paper provides an insight to how this policy is carried out, the elements stressed upon in the policy and, the reported responses of the athletes themselves on their beliefs on how sport has brought them together as a team.

## O104E-4

**The online coverage of sport in the popular and quality press in England, Germany and Austria**

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*Keywords: on-line coverage, popular press, quality press*

Interactive media have grabbed the attention of communication researchers in the latter half of the 1990s, but the focus to date has been primarily on media audiences and their use of these new forms.

This paper explores six Internet versions of newspapers - The Sun / The Guardian (GBR), Die Bildzeitung / Die Frankfurter Allgemeine Zeitung (GER), Die Kronenzeitung / Der Standard (AUT) - especially their sport coverage. It looks at the technologies used by these newspapers, compares them on the basis of the type of reporting, and explores reasons why there are differences between the quality newspapers and the popular online newspapers.

The study found, through content analysis of the sites, that the popular online newspapers have adopted more interactive innovations than the quality papers. In the field of reporting type, the popular newspapers emphasised more in the categories of the 'reportage' and 'interview' than the quality online versions, which focused on the category 'news'. These tendencies illustrated the purpose of the popular newspapers to present sport as spectacular entertainment and to build virtual communities for optimizing the consume possibilities. The concentration of the popular sport coverage on the categories 'reportage' and 'interview' documented increasingly tendency of personalization.

O104E-5

### Newspaper coverage of women's sports during the 2000 Sydney Olympic Games: A European study

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**Keywords:** *women's sport, gender coverage, Olympics*

The relationship of gender in regional media sport cultures has been largely unexplored. To give a cross-cultural analysis of women's sport coverage the aim of the present study is to examine the print media coverage of the 2000 Summer Olympic Games in four European countries.

Only stories and photographs focusing on Olympic athletes and published on the most sold daily newspaper of Belgium, Denmark, France, and Italy were considered. Five indicators measured the press coverage: 1) the number of articles, 2) the height and width of articles, 3) the page placement of the article, 4) the number of photographs, and 5) the size of the picture. Stories and photographs were classified into men-only (M), women-only (F), and mixed men and women (MF) categories. A 0.05 level of significance was selected for Chi-square and analysis of variance to test for statistical significant differences of percentages or sizes, respectively.

Although the number of articles ( $F = 36.1\%$ ,  $M = 63.9\%$ ) showed significant gender differences ( $\chi^2$  value = 298.5;  $p < 0.001$ ), the newspaper reports were very similar to the distribution of the participating athletes and events. Regarding the size of articles, statistically significant differences were found among countries ( $p < 0.001$ ), and for the interaction between gender and countries ( $p < 0.05$ ), while no significant difference was shown between gender. A total of 3011 photos were published, 33.5% F, 56.2% M, and 10.3% MF. When the size of photos was considered, higher values were found for the F category ( $189 \pm 196 \text{ cm}^2$ ) as compared to the MF ( $182 \pm 179 \text{ cm}^2$ ) and to M ( $176 \pm 204 \text{ cm}^2$ ) categories, and statistically significant differences were found only among countries ( $p < 0.001$ ).

According to the literature, there is a close relationship between female athletes participation in the Olympic Games and women's sport media attention (Toohey, 1997; Capranica et al, 2001). This is due to the fact that National identification fosters the global sport phenomenon and enhances audience's attention (Stevenson, 2002). Moreover, the size of articles and photos was similar for both genders, indicating that the gender discrepancy is not present in the Olympic coverage.

Capranica L et al (2001). *Italian Journal of Sport Sciences* 30-34

Stevenson D (2002). *J. Sport & Social Issues* 26: 209-225

Toohey K (1997). *Int. Rev. Sociol. Sport* 32: 19-29

O104E-6

### Sport, identity and mythology in contemporary Brazil

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**Keywords:** *society, national identity*

Sport, one of the most important leitmotifs of modernity, is in the centre of the national identities. It's not different in South America, mostly in countries like Brazil and Argentina, where the sport tradition and idols play a very import role in the national proud. We find in these countries several examples

of the relations between sport and the construction of identities, especially after the second half of the last (short) century. In this paper we intend to present some elements of the construction of the national identity by sport, studying the imaginary concerning four Brazilian 'national heroes': the soccer player Pelé, the chess player Mequinho, the driver Ayrton Senna and the tennis player Gustavo Kuerten.

For so much we have selected and analysed reports, chronicles and headlines of Brazilians daily newspapers and weekly magazines in several periods between 1970 and 2000. For each one of those actors we chose an important episode of their careers: Pelé's first soccer farewell; Mequinho's most important championship victory; the death of Ayrton Senna; Gustavo Kuerten's second triumph in French Open. The episodes were analysed in their singularities and in they possible relations.

The results point to important differences in the construction of each one of the 'heroes'. Pelé is an Afro-Brazilian and the greatest idol in a country where the racial democracy is still misunderstanding; Mequinho is the man who proved that the Nation could be simultaneously so brilliant with brain as it was with the feet; Ayrton Senna was the human who dominated the machine, with courageous and efficiency; Gustavo Kuerten represents, however, the image of the 'good boy', descendent of Europeans, linked to his family, to social causes and fair play. These 'heroes', in spite of their contradictions, seem to be 'reconciled' in the social imaginary about Brazil and its cultural phenomena.

This 'reconciliation' that conforms Brazilian identity can be found also in other social and historic fields, showing some correspondences, but also discontinuities, between sport and other social phenomena. The production of these national pride images, as much of Pelé as of Mequinho, Senna and Kuerten, cannot be seeing divested of contemporary sport configuration: between globalization and nationalisms, faith and science. Each one of four idols is also expression of media. These images are also an answer of culture industry on our desires, lacks, hopes and despairs.

O104E-7

### Non verbal communication in sports training

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**Keywords:** *specialized communication area, paralinguage, praxis communication*

In the specialized communication area, sport training field, it is necessary to take a series of current communication codes in specific human groups into account which allows to improve the quality of training and competence of both sportsmen and trainers.

In the sports field, there is a great variety of environments which interact directly with the music field. That is why some previous researches performed at the University of Antioquia, Medellín, Colombia have studied the value of the analysis of the non-verbal specialized communication in these two fields of knowledge (Ocampo 1999, Plested, Vallejo, Zapata, 2000; Velásquez, 2000).

This paper will feature an advance of the research "Terminological Applications in Music and Sport Training" in which it is analyzed some aspects of non-verbal communication in the specific context: non-verbal language, paralinguage, codes, signals, Kinetics, etc. as seen from the theory of the terminological modeling and the praxis communication.

**Methods**

- Working Languages: Spanish and German

- Precision of primary Corpus
- Field Work (video, tapes, interviews)
- Terminological tracking of non- verbal documental material, electronic format
- Terminological Tracking of Concepts, representations and non-verbal terms

- Semiotic analysis of non-verbal conceptual units
- Theoretical reflection: Terminology, non-verbal communication, specialized language, Musical language, Sport language
- Analysis of selected information

## Symposium

### Resistance Training for the Elderly (ACSM Exchange Symposium)

**S104F**

#### S104F-1

#### Mechanisms of muscle strength and mass changes with resistance training in older people

**Harridge Stephen**

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*Keywords: age, muscle, IGF-I*

One of the features of the ageing process is the loss of muscle mass or 'sarcopenia'. However, there is now good evidence that even in very elderly people (+85 years), muscles will adapt to high resistance training, but the mechanisms by which these adaptations occur are still not fully understood. For a muscle to hypertrophy there must be a net accumulation of protein. Recent studies have shown that older people may have lower rates of protein synthesis compared to young people, but that resistance exercise can increase these protein synthesis rates in proportion to those observed in younger subjects. In addition, a fibre needs to maintain an appropriate ratio of DNA to protein. For a muscle to adapt, new nuclei must be provided to parallel the increase in fibre volume. This may be provided by the activation of satellite cells. There is increasing evidence that IGF-I, particularly IGF-I produced locally in muscle may play an important role in both stimulating muscle protein synthesis and in the activation of satellite cells in muscle. It is now clear that at least 3 isoforms of IGF-I (IGF-IEa, IGF-Eb and IGF-IEc) are expressed in human muscle which arise from a process of alternative splicing of the IGF-I gene. It seems that these isoforms may have different physiological roles. One isoform (IGF-IEc) has been termed mechano-growth factor or MGF is of particular interest as it appears to be sensitive to the signals which occur from mechanical overload or high resistance exercise. We have recently demonstrated that young subjects can increase the expression of the mRNA of this isoform 2.5 hours after a single bout of high resistance exercise (Hameed et al. 2003). In older subjects no consistent increase was observed. However, in contrast to a one off bout of exercise a period of strength training has been shown to increase MGF and IGF-IEa mRNA (Hameed et al. 2003) and also IGF-I protein levels (Singh et al. 1999) in the muscles of older subjects. Importantly these studies did not simultaneously investigate young subjects to determine if there was an age related alteration in the ability of muscle to upregulate these growth factors. Whether or not an older persons muscle remains as adaptable as younger persons muscle remains to be established.

*Hameed et al. (2003a) J. Physiol. 547: 247-254*

*Hameed et al. (2003b) J. Physiol. 547.P:C118*

*Singh et al. (1999) Am J. Physiol. 277 E135-E143*

*Yang et al. (1996) J.Muscle Res.Cell Motil. 17, 487-495*

#### S104F-2

#### Changes in muscle composition with age and resistance training

**Andersen Jesper L, Kryger A**

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*Keywords: muscle, resistance strength training, aging*

The proportions of our skeletal muscles change as we age. Aging is associated with pronounced muscle atrophy, muscle weakening and slowing. Resistance training, on the other hand, induces hypertrophy and muscle strength (Andersen & Aagaard, 2000). It is therefore obvious to think of resistance training as a mean to counteract aging related decay of the skeletal muscles. Several studies have shown pronounced atrophy of both the skeletal muscles and the individual muscle fibres in aged subjects. We present data that shows pronounced increase in fibre size in a group of frail elderly with an average age of 88 years after 12 weeks of heavy loaded resistance training (Andersen & Kryger, in prep.). Furthermore, our data on this group of subjects shows that the hypertrophy is restricted to the fast type II fibres, accompanied by a normalisation of the morphological appearance of the fibres in general, and a pronounced increase in strength.

Most studies seem to indicate that there is no apparent change in fibre type composition with aging, although some studies have found a slight increase in the amount of slow type I fibres when compared to younger subjects. Our data showed on average 46% type I fibres evaluated in percentage number, but above 60% when evaluated as percentage type I area. With the alleged selective hypertrophy of the type II fibres the percentage type I area numbers should approach each other after resistance training, which was exactly what we observed.

Conclusively, our data showed that very elderly subjects had extensive fibre size atrophy that could be counteracted by heavy resistance training. Furthermore, the subjects showed no sign of an altered fibre type composition in regards to percentage number, but a higher type I fibre type area percentage. Resistance training seems to be able to counteract the latter. Together with increased strength, increased muscle mass and a increase in the relative amount of the muscle cross-sectional area covered by fast type II fibres, resistance training seems to be a obvious choice in improving life quality for the elderly.

*Andersen & Aagaard, Muscle & Nerve, 23, 1095-1104, 2000*

*Andersen & Kryger, in prep.*

## S104F-3

**Effect of strength training on functional ability and risk of falls in elderly people****Beyer Nina**

Bispebjerg Hospital, Denmark

*Keywords: functional abilities, resistance exercise, accidental falls*

Muscle weakness is one of the underlying mechanisms of poor function. Muscle strength correlates with several measures of functional status in elderly persons. In addition, it has been shown that sarcopenia is significantly associated with a 3-4 times greater risk of physical disability and a 2-3 times greater risk of falls.

Muscle strength can be improved by high-intensity resistance training even in the oldest old. It would thus be reasonable to assume that an increase in muscle strength would lead to an improvement in function. Studies with resistance exercise alone have resulted in both increased muscle strength and improved functional performance in the frail elderly, and similar results have been found in the elderly with comorbidity.

However, improvements in strength do not always translate into improvements in daily function in the home-dwelling elderly persons with a higher functional level. It has been suggested that the association between strength and function is curvilinear. Data indicate that a critical amount of strength is needed for normal performance of specific activities. Below this threshold there should theoretically be a stronger relation between a change in strength and performance, and above this threshold level of strength, a further increase in strength will not enhance performance of the task. Combining resistance exercise with functional training has resulted in more functional gains both in non-frail elderly and frail elderly.

Regarding falls prevention recent studies have shown that exercise stand-alone can lead to a significant reduction in falls in elderly people 70 years and over. The exercise programmes in those studies mainly consisted of resistance exercises and balance training. Preventing falls in the elderly is important because falls and injury may lead to a spiral of inactivity and decline that take older people close to or below the critical "thresholds" of performance necessary for everyday activities. An algorithm summarizing the clinical approach to prevention of falls among elderly persons recommend that those who have fallen participate in an exercise program that includes balance and strength training.

This is in accordance with a recent study in elderly women who had suffered an accidental fall where progressive resistance and balance training resulted in marked clinically relevant improvements in muscle strength and functional performance.

## S104F-4

**Aging and resistance exercise: effects on body composition and functional capacity****Evans William**

University of Arkansas for Medical Sciences, United States

*Keywords: sarcopenia, frail elderly, protein requirement*

Advancing age is associated with profound changes in body composition age-related loss in skeletal muscle has been referred to as sarcopenia and is a direct cause of the age related decrease in muscle strength and increased risk of disability. With advancing age and extremely low activity levels seen in the very old, muscle strength is a critical component of walking ability. The high prevalence of falls among the institutionalized elderly may be a consequence of their lower muscle strength. The preservation of muscle mass and prevention of sarcopenia can help prevent decreases in metabolic rate. Sarcopenia may contribute to such age-associated changes as reduction in bone density, insulin sensitivity, and aerobic capacity. High intensity resistance training (80% of 1 repetition maximum, 3 days/week) has been demonstrated to result in significant and substantial improvements in strength and muscle size in elderly people, even in the oldest. In very old, nursing home patients (mean age, 85 yrs), resistance exercise increased skeletal muscle IGF-1 levels and the amount of muscle hypertrophy is closely related to dietary energy intake. Resistance exercise has also been shown to result in increased bone density, energy requirements, balance, spontaneous activity levels, and muscle protein synthesis. We have also demonstrated that strength training enhances protein retention, thus reducing dietary protein is needed in the elderly. In addition resistance training improves bone health and increases daily energy needs of elderly people. Thus resistance exercise training may arrest sarcopenia and allow elderly people to live functional, independent lives.

**Symposium****Coordination Dynamics and its Relevance to Sport and Exercise****S104G**

## S104G-1

**Coordination dynamics and its relevance to sports****Schöllhorn Wolfgang**

University of Münster, Germany

*Keywords: motor learning, coordination dynamics, individuality*

Epistemologically inspired by different scientific subjects like ecological psychology and statistical physics, questions of holism, emergence, and fluctuations became core elements in the analysis of motor control by the coordination dynamics approach. Thereby the objectives are treated on a fairly abstract level in order to achieve most generality and

facilitate transfer among the findings. Holism addresses several areas, whereof here three are of central interest for sports science: firstly, a moving person is no more considered as an isolated hierarchically controlled system but is rather assumed as heterarchically structured and embedded in complex interactions with an environment, secondly, increasingly, moving systems are no more reduced to single variables but rather are analysed by groups of variables, indices or holistic parameters, and thirdly, states and phases are no more considered as final results but rather as situations within continuously changing processes which pass zones of more or less stability. In this connection the field of emergence allows different approaches to the analysis of qualitative changes in motor learning. The concept of fluctuations leads to a changing interpretation of

movement errors which are no more considered to be avoided, but rather are seen as a necessity for adaptive systems. Whereas the direct influence on sports science can be described on a more epistemological level which changed the approaches of quantitative analyses, the indirect influence is going to change the practical contents of sports fundamentally. Some of the more theoretical findings in sports science will be shown before experiments as consequences of forecasts with respect to the acquisition and training of sports techniques are introduced. The theoretical relevance is mainly related to the manner of analysis. For several types of whole body movements the individuality of movement patterns could be shown and lead to rethink the idea of general prototypes. The low probability of identical movements displays that even after thousands of repetitions new elements will inhere. As a practical consequence the concept of learning on differences was derived, with which training should prepare the athlete to adapt on new situations in a shorter time and more adequately. In several experiments the differential learning approach was compared with traditional approaches and lead to significantly higher learning progress in all cases.

### S104G-2

#### Self-stabilized movement patterns in sports

**Wagner Heiko, Blickhan Reinhard**

Friedrich Schiller University Jena, Germany

*Keywords: muscle, modelling, self-stability*

Especially in the field of sports the robustness or stability of a movement pattern or the performance of a special technique is very important. Success in sports is based on years of training and the robustness or stability of a technique should be a major goal. The question arises which properties of the musculoskeletal system are responsible for movement stabilization? Reflexes can support stability but the neuronal system reacts with a delay. Therefore, especially for very fast movements this type of stabilization may be too slow.

On the other hand recent investigations have shown that much of this performance may rest on carefully adjusted properties of the mechanical system and its intelligent use. The open loop stabilization based on mechanical properties of the musculoskeletal system has been termed self-stability. Here we would like to give a short overview of several studies we made to investigate some of these questions. We will investigate the self-stability of single muscle contractions, i.e. quick release contractions, cyclic leg movements, juggling and tennis. The results will be discussed in terms of the relevance of self-stability in the field of sports science.

### S104G-3

#### Coordination dynamics during the motor learning process

**Vereijken Beatrix**

Norwegian University of Science and Technology, Norway

*Keywords: variability, dynamics, exploration*

With the introduction of dynamic systems into the field of movement science, new tools and methods have become available to study motor learning. In this presentation, I will illustrate the relevance of several 'dynamic concepts' for our understanding of motor learning. First, I will present two studies on the learning process in children, as children are among the most efficient learners we know. Subsequently, I will present a series of studies on adult learning.

Once children have managed their first independent steps, many years follow in which their walking patterns become increasingly reliable and efficient, and slowly but surely adopt adult characteristics. Results of a large study on learning to walk indicated that these improvements were mainly due to extended practice, not physical growth or neural maturation per se. Furthermore, children's everyday experiences with walking occurred in massive doses that were distributed within and across days, and in a wide variety of events, places and surfaces. The general benefit of such training schedules is increased flexibility and positive transfer under novel conditions.

As another study on learning to crawl illustrated, variable practice can also enhance transfer to novel skills. Results indicated that prior experience with belly crawling facilitated performance after the transition to hands-and-knees crawling. Whereas belly crawling was characterised by insistent variability and exploration, hands-and-knees crawling was characterised by consistent stability. I will argue that dissimilarities in task dynamics can provide insight into this difference.

The relevance of exploration for the motor learning process can also be pointed out in adults. As a series of learning experiments on a ski-apparatus demonstrated, focusing the learner's attention on specific elements of the task worsened overall performance. In contrast, those left to explore the task learned better, quicker, and more comprehensively how to perform the task. Again, analysis of the task dynamics indicated why this might be so.

In conclusion, concepts from dynamic systems perspectives are helpful when trying to understand the process of motor learning. The existence of individual differences and the influence of a multitude of interacting factors present us with a formidable challenge in developing a comprehensive theory of learning. I will argue that to date, dynamic systems theory is the best candidate to meet these challenges.

### S104G-4

#### Variability and fluctuations: Errors or key factors for performance

**Balague Natalia, Torrents Carlota**

INEFC Barcelona, Spain

*Keywords: variability, fluctuations, dynamic systems*

Variability and fluctuations are considered as sources of error in classical research designs. Measurement devices and perturbations of the environment often introduce noisy effects that have to be controlled or discarded to get valid and reliable data. However variability is also introduced by the subjects. In fact, data obtained by human beings are irreproducible by nature. Such variability, that is seen as a problem in the classical point of view, can be very informative according to the coordination or systems dynamics approach. Behavior and evolution of systems are characterized by self-organization. Systems shift into new forms only as the old forms get shaken up by perturbations. The variability generated gives information that can be related to different aspects of sport performance.

Results of different physiological and biomechanical studies show applications of the fluctuations analysis to:

- Identify non parametric changes or phase shifts. Despite many phenomena act parametrically within certain ranges of a control parameter some changes in systems are pattern shifts. They use to be neglected or hidden in conventional data collection.
- Anticipate pattern changes in the behavior of the athlete. These changes are bifurcations characterized by an



enhancement of fluctuations. Increase of variability is also associated to variations in the regulation of physiological functions during training processes and can be useful to detect critical periods during the development.

- Analyze the ability of the athlete to adapt to external or internal changes. Decrease of fluctuations or variability are associated to some pathologies and limits of physiological functions.

- Diagnose the initial state of the athlete. Variability and fluctuations can be used to analyze the distribution of the attractors in the state space.

Some examples of the previous points and two studies showing applications of time series analysis will be presented to discuss how fluctuations can act as key factors for performance instead of errors of the measure.

#### S104G-5

### Optimisation of complex movement patterns (handball throw) - motor development and the variation of kinematic and EMG parameters

**Wagner Herbert, Müller Erich, Kösters Alexander, Von Tschanner Vincent, Brunner Fritz**

Institute of Sport Science, University of Salzburg, Austria

*Keywords: handball, dynamic patterns, variations*

In Sport Science two different types of motor learning theories were discussed, the theory of motor programming and dynamic patterns. For the exponents of dynamic patterns (Kelso 1999) it is necessary to produce errors (variations, differences) following the theory of differential learning (Schöllhorn 2003).

The first subject (TS) practised a training program based on the theory of differential learning by determining the motor

development before and after every part of the training (M1 to M2 and M3 to M4: Differential learning; M2 to M3: "Classical" learning) for the second subject (MS) the condition of the parameters was upraised only for one point at time. For both subjects kinematics and ball-velocity and the EMG of seven muscles were measured. At first the affinity of all angle courses of the TS compared to the angle course with the highest ball velocity was calculated, using orthonormal reference functions. It is represented by the affinity parameters of begin (first point), intensity (max - min) and the standardised time course. Then the variations of kinematics were calculated by the variance of all affinity parameters. For the EMG parameters the distance between the activity of every muscle and the average activity was calculated by using wavelets.

Ball-velocity increases within the first part (M1 to M2: Sig. 0.000), decreases within the second part (M2 to M3: Sig. 0.007) and increases again after the third part of the training (M3 to M4: Sig. 0.000). The difference between the ball-velocity of the MS and all measuring points of the TS is also highly significant (TS M1/M2/M3/M4 to MS: Sig. 0.000). Therefore the practised training method of differential learning is very effective instead of classical learning which is counterproductive to the quality of throwing metered by the ball velocity. The variation of all angle courses calculated by the mean values of the variances of all parameters (begin, intensity and course) increases from every part of the training. The difference between the M1, M2 and the output test (M4) was significant (Sig. <0.05). The results indicate that the distance depends on the quality of throwing. At the TS M4 and MS where ball-velocity was highest the distance to mean activity and the test to test distance was greatest.

It can be concluded that the variation is an important condition for learning and also for top performances in sports especially in handball throwing.

## Symposium

### Measurement of Physical Activity

**S104H**

#### S104H-1

### Measuring physical activity by self-report questionnaire in an adult Danish population

**Aadahl Mette, Jørgensen Torben**

University of Copenhagen, Rigshospital, Denmark

*Keywords: physical activity, epidemiology, questionnaire*

When exploring the association between physical activity and health or when monitoring interventions aimed at increasing physical activity level, we need simple, valid and reliable methods for measuring physical activity. In large-scale population-based studies as well as in patient rehabilitation settings we need instruments that are feasible and easy to administer. Self-report questionnaires are traditionally the instrument of choice and ideally questionnaires should provide detailed information on physical activity rather than a crude classification of physical activity level.

The aim of the present study is to describe self-reported physical activity level in a Danish general population.

We developed and validated a new self-report questionnaire for measuring physical activity level on an average 24-hour weekday. The questionnaire takes 5-10 minutes to fill out; it allows calculation of total MET-time (metabolic equivalent) on an average 24-hour weekday and estimation of energy expenditure.

The new questionnaire was applied in the three-year follow-up of an on-going population based intervention study: The Inter 99 study. The study was initiated in 1999 and a total of 13,016 persons were randomly selected from the background population and invited to a risk assessment for ischaemic heart disease. Participation rate at baseline was 52% (N=6,784) Individuals at risk were offered an intervention focussing on increase in physical activity and change of diet. Approximately 1200 men and women between the age of 30 and 60 are scheduled to fill out the new physical activity questionnaire at the 3-year follow-up. A preliminary description of physical activity patterns in relation to sex, age, blood pressure, body mass index, cholesterol and waist-hip ratio in this population will be presented.

## S104H-2

**Measuring physical activity by questionnaires in consideration of their calibration****Wagner Petra, Singer Roland**

University of Bayreuth, Germany

*Keywords: physical fitness, physical activity, immune function, elderly*

Many epidemiological, naturalistic as well as experimental studies were taken to examine the relationship between physical activity and health. In current publications regarding the measurement of physical activity a stronger calibration of the measurement procedures for different subpopulations is required (Wood, 2000) to reflect more appropriately the different parts of life and activity patterns of these groups. Therefore we attempted to consider these demands for more specific measuring methods in a survey with adults over several years.

According to the "Questionnaire for the measurement of habitual physical activity in epidemiological studies" by Baecke, Burema & Frijters (1982) the extent of habitual physical activity was assessed differentiating between the three sectors "work", "sport" and "leisure time" and consisting of 16 items in all. Between April 1997 and June 2000 data from 1928 adults (996 men; 932 women) aged 20 to 65 was collected by means of a German version of the questionnaire of Baecke et al. (1982) and a 14-days diary of activities.

The results of our factor analysis confirmed the three factor structure found by Baecke et al. (1982). This emphasise that the three above-mentioned sectors of activities "work", "sport" and "leisure time" are almost independently represented. A regression analysis shows that all three dimensions make a significant contribution to the prediction of the overall activity, also in different subpopulations. But the relevance of the dimensions is not the same for the different subpopulations.

The three dimensions of activities have to be taken into consideration for a more specific measurement of physical activity for adults. This is even more important as the relevance of the dimensions for the explanation of variance of overall physical activity vary in the different subpopulations. This means that if the activity of only one sector (e.g. sport) was just taken into consideration when measuring, the true extent of "habitual physical activity" in the subpopulations would be over- or underestimated. Our results corroborate the belief that at least these three dimensions should be assessed in order to measure physical activity of adults more appropriately.

Ainsworth BE (2000). *Research Quarterly Exercise and Sport* 71, Suppl to No 2, 37-42

Baecke JAH, Burema J, Frijters JER (1982). *American J Clinical Nutrition* 36: 936-942

Wood TM, (2000). *Research Quarterly Exercise and Sport* 71, Suppl to No 2, II-VI

## S104H-3

**Measurement of physical activity****Froberg Karsten**

University of Southern Denmark, Denmark

*Keywords: physical activity, health, objective measurement*

The development of new objective instruments for the measurement of physical activity in free-living individuals offers us the opportunity to understand the relationship between activity and health outcomes better than in the past.

The ability to measure the volume, duration and intensity of activity in detail over a prolonged period should allow us to better recommend activity programmes that would be effective in the prevention and management of ill health. In addition, the use of feedback from these instruments will allow us to monitor individual achievement of physical activity targets to encourage not only the adoption but also the maintenance of a more active and hopefully healthier lifestyle.

More than 30 different instruments for assessment of physical activity have been developed over time and range from subjective measures (questionnaires, activity diaries, interviews, proxy reports) to more or less objective measures (behavioural observations, heart rate monitors, motion sensors, calorimetry). The large number and great diversity of methods available witness the difficulty of this task and the complexity of the parameter. It is important to recognize that any of the available methods have the potential of providing information. Question is, what is really being assessed, and is that specifically relevant to the research question.

This presentation will concentrate on how physical activity is measured with motion sensors, with special reference to the reliability and validity of CSA, Inc. Model 7164 accelerometer. It will also include the combining of the heart rate (HR) monitoring and accelerometry which has shown having advantages over either method used alone, because it improves the precision of the objectively measure of physical activity energy expenditure estimates during daily activities.

## S104H-4

**Determination of energy expenditure by the heart rate flex method and its application to school aged children****Schmidt Walter, Fröhlich Hanno**

University of Bayreuth, Germany

*Keywords: heart rate, energy expenditure, school sports*

Physical activity during childhood is assumed to maintain and improve health as well as to avoid obesity. To take proper counter-measures against excessive positive caloric balance the knowledge of energy expenditure (EE) is necessary. The first aim was to evaluate the heart-rate monitoring method, which is based on the fact that heart rate and O<sub>2</sub>-consumption show a close relationship, as a valuable method to determine EE. The second aim was to apply this method to determine the EE during single school sports units and during days (12h) with and without school sport.

1. 11 adults (G1: 28±3,2 years, BMI 23,6±1,5) and 5 children (G2: 13±0,7 years, BMI 19,3±3,4) were included into the study. For all subjects individual HR-VO<sub>2</sub>-regression was determined from rest until maximum output during treadmill, step-test and cycle-ergometer exercise. For the validation of the calculated EE at different free living conditions we compared them with direct spirometric measurements of VO<sub>2</sub> for 1,5h (G1) and 1h (G2) for the work-conditions PC-work (PC), walking (W), basketball (BB) and Isometric strength unit (IS).

The mean deviation for G1 was: (PC) 13,6±18kcal (11±15%); (W) 8,2±26,6kcal (7±19%); (BB) 4,8±12,3kcal (3±7%); (IS) 56,2±29,2kcal (75±36%). The mean deviation for G2 was: (PC) -0,76±0,86kcal (-5,4±6,4%); (W) 4,6±3,1kcal (17,7±13,3%); (BB) 5,2±2,5kcal (6,5±3,2%); (IS) 28,6±6,9kcal (54,8±13,92%).

2. In two groups (G13, n=15: 13±0,5 years; BMI 19,1±2,5; and G16, n=14: 16±0,9years; BMI 21,8±2) the 12h-energy expenditure (12h-EE) on days with (DwS) and without school sport (DwoS) was measured. In 22 subjects (G12:

12±0,5years; BMI 19,5±3) EE was recorded during seven school sports units (90min). 12h-EE of G13 for DwoS was 1273±237kcal and for DwS 1699±259kcal. The 12h-EE of G16 for DwoS was 2173±626kcal and for DwS 2444±625kcal. The individual and average EE of G12 for the single sports-units were extremely different ranging from 75,1±45,2kcal to 272,3±107,9kcal.

1. The HR-monitoring-method is - except static strength loads - both for children and adults an objective and practical

possibility to quantify the EE under free living conditions. 2. The EE during different school sports units show high day to day and high individual variations. In case of performing good school sports, there exists a big difference in EE for days with and without school sport. Physical education therefore offers a good possibility to raise the EE of children and adolescents.

## Oral Session

### Biomechanics 5: Reflex and Stimulation

O104I

O104I-1

#### Reflex sensitivity during isometric, concentric and eccentric actions

**Kallio Jouni, Linnamo Vesa, Avela Janne, Dousset Erick, Ishikawa Masaki, Kuitunen Sami, Kyröläinen Heikki, Komi Paavo**

Neuromuscular Research Center, Finland

*Keywords: stretch reflex, H reflex, muscle activation*

Recent studies (Ogiso et al. 2002; Kallio et al. 2002) have shown that the short latency component of the stretch reflex (SLR) is dependent on stretching velocity, magnitude and type of preceding muscle activity. The changes may be due to alterations in the motoneuron pool excitability as indicated by the behaviour of the electrically induced H-reflex. The purpose of the present study was to investigate whether the preceding magnitude and type of preceding muscle activation would affect both mechanically and electrically evoked reflexes in a similar manner.

Mechanical (stretch) and electrical (H-reflex) stimuli were elicited to the triceps surae muscle in three different pre-conditions: isometric (ISO), lengthening (LEN) and shortening (SHO). Measurements were performed with both passive and active muscle. All stimuli were applied at the same ankle joint angle (1.8 rad).

In passive muscle the SLR peak-to-peak amplitude and reflex torque were higher in ISO compared to dynamic (LEN, SHO) conditions. However, the H-reflex / M-wave - relationship was smaller in LEN compared to both ISO and SHO. In active muscle the SLR peak-to-peak amplitude in LEN was smaller than in ISO or SHO. The H/M-relationship was highest in SHO and smallest in LEN. In active conditions the torque preceding the stimuli was highest in LEN and smallest in SHO. However, the EMG activity (RMS) preceding the stimulus was higher in SHO compared to the other conditions.

Present results support the hypothesis of spindle slackening (Gregory et al. 1987) as the reason for smaller SLR amplitude in passive SHO compared to ISO condition. The higher H/M relationship in active SHO compared to LEN and ISO conditions could be due to higher EMG activity preceding the stimulus. In passive muscle both SLR amplitude and H/M were smaller in LEN than in ISO, suggesting reduced alpha-motoneuron pool excitability. This lower response in LEN compared to ISO or SHO persisted with activation although the EMG activity level was similar in LEN and ISO. This would indicate that the observed smaller stretch response in active LEN condition results from inhibition of the motoneuron pool instead of reduced spindle sensitivity to stretch.

*Gregory et al. (1987). J Neurophysiol Vol 58: 628-640.*

*Kallio J et al. (2002). ECSS proceedings 2: 667.*

*Ogiso K et al. (2002). J. Electrom Kinesiol. Vol 12: 17-26.*

O104I-2

#### Training induced adaptations in reflex - characteristics of elderly men

**Granacher Urs, Strass Dieter, Gollhofer Albert**

University of Freiburg, Germany

*Keywords: perturbation, aging, sensorimotor training*

The aging neuromuscular system is affected by various degenerative processes (e.g. reduction in number and size of type-II skeletal muscle fibres and their motoneurons, desensitization of mechanoreceptors) (Lexell et al. 1988; Mynark/Koceja 2001) leading to a general slowing down of neuromuscular performance (Strass/Granacher 2000). As a consequence, the process of aging results in a modulation of reflex pathways, which often confronts elderly people with problems compensating for surface irregularities during gait. The outcome is an increased risk of falling, which could be prevented by an adequate training intervention. Therefore, the purpose of the study was to examine the impact of heavy resistance strength training (HRT) and sensorimotor training (ST) in elderly men on unexpected treadmill and platform perturbation (PB).

60 healthy male subjects (age 66,5 SD 4,6yrs) were pre-tested on treadmill and platform PB and randomized into either a treatment or a control group (CG). Half of the treatment subjects participated in 12 weeks of lower limb HRT (N=20); the other half in ST designed to stabilize posture (N=20). Both intervention groups and the CG (N=20) were then post-tested on decelerated treadmill PB while walking at a speed of 3,5km/h and medio-lateral platform PB (unilaterally performed). EMG signals were recorded from M. tibialis anterior (TA) and M. soleus (SO). Ankle joint movements (AJM) were indicated by a goniometer.

Subjects who received ST demonstrated in both measuring sections a significantly facilitated neural drive in TA and a significant reduction in range and velocity of AJM. Additionally, both intervention groups significantly decreased their neural drive in SO at treadmill PB.

Results indicate that ST has an impact on spinal mechanisms in the elderly. It is possible that the facilitated neural drive (TA) is due to an improved afferent sensory input which again influences the efferent muscular output. The findings demonstrate that even in the elderly a sufficient training stimulus has a significant impact on the reflex system. Therefore, ST appears to be a well-suited method for fall preventive programs in elderly people.

*Lexell J. et al (1988). J Neurol Sci 84: 275-294*

*Mynark R.G., Koceja D.M. (2001). J Appl Biomech 17: 188-203*

*Strass D., Granacher U. (2000). Sportwissenschaft 30 (4): 471-480*

O104I-3

**Neural activation of the knee extensor muscles in seated vs. supine position****Maffiuletti Nicola A, Lepers Romuald**

Faculty of Sport Science, University of Bourgogne, France

**Keywords:** neural activation, EMG activity, knee extensors

Babault et al. (2003) have recently demonstrated that, by modulating vasti and rectus femoris (RF) muscle length through knee flexion, neural activation is higher for the shortened compared to the lengthened quadriceps. However, little is known about knee extensor neural activation and the associated torque output while only the RF muscle is in a shortened position (seated) compared to a lengthened position (supine). Therefore, it was hypothesised that neural activation would be higher in the seated position, when RF muscle fibers are shortened by the flexion of the hip joint.

Eleven males performed maximal voluntary contractions of the knee extensor muscles under two different experimental positions: (i) seated with a 90° hip angle and (ii) supine with a 180° hip angle. The knee joint was fixed at 90° of flexion during the entire experiment. EMG activity was recorded from the vastus medialis, vastus lateralis and RF muscles and subsequently normalized to the amplitude of the maximal M-wave for respective muscles and for respective hip positions. Activation level was also estimated according to the twitch interpolation technique.

Maximal voluntary contraction was significantly higher in the seated compared to the supine position ( $P = 0.004$ ). The mean relative difference between the two postures was  $10.6 \pm 11.2\%$  and only one subject was stronger under supine conditions. Normalized EMG activities of vastus medialis, vastus lateralis and RF muscles were significantly higher in the seated vs. supine position ( $P < 0.05$ ), respectively 17, 23 and 41%. Similarly, activation level was significantly lower ( $-4.8\%$ ;  $P < 0.05$ ) under supine conditions.

The main finding of this investigation is the significant decline of maximal voluntary knee extensor torque, surface EMG activity and activation level with increasing RF muscle length, i.e., in the supine position. These results confirm the hypothesis that neural activation of the knee extensors is higher at short muscle length. Task familiarity is certainly a contributing factor, as also discussed by Pavol and Grabiner (2000). Improved motor unit discharge rate and/or motoneuron excitability within the shortened RF muscle may be hypothesised to be responsible for the higher neural activation found in the seated position (see also Babault et al. 2003).

Babault N et al (2003). *J. Appl. Physiol.* 94:983-990Pavol MJ, Grabiner MD (2000). *Med. Sci. Sports Exerc.* 32:985-992

O104I-4

**Assessment of plantar-flexors activation capacity with single and double pulses: effects of technique and age****Scaglioni Gil, Martin A, Minetti AE, Van Hoecke J, Narici MV**

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**Keywords:** m. triceps surae, aging, twitch interpolation

Pulse train stimulation may be considered a more reliable technique to assess the level of activation capacity (AC) than single pulses since it relies both on motor units (MUs) recruitment and on rate coding (Behm, 2001). However, the discomfort caused by multiple pulses generates some

concern particularly when applying this technique on an elderly population. Thus the aim of this study was to ii) compare the effects of single or double pulses on the estimation of plantar flexors (PF) AC with ageing and ii) to evaluate possible differences in recruitment strategy between young (YS) and elderly subjects (ES).

To this aim, 10 YS ( $25 \pm 5$  yr) and 7 ES ( $71 \pm 2$  yr) performed isometric contractions of the PF, from 20 to 100% of maximal voluntary torque (MVT). The two stimulation techniques were compared by fitting the data with a curvilinear function ( $MVT(\%) = a[(1-b)ecPta + b(1-Pta/d)]$ , eq.1, Scaglioni et al. 2002), where coefficient a represents the estimation of MVT (%) for  $Pta=0$ , b weights the linear and exponential data-set, c indicates the degree of concavity and d the twitch torque (%) for  $MVT=0$ . No difference in the assessment of the coefficients of eq.1 was observed between the two experimental conditions. AC, calculated as  $1-(Pta/peak\ twitch)*100$ , was not influenced by the technique and did not statistically differ between YS and ES. The absence of differences in coefficients values appraised by the two techniques enabled to collapse for both groups the single and double twitch data and construct the Pta-torque relationship (Pta-T) on a larger number of points. No effect of age was found in the coefficients values of eq.1, except for c with a difference of 32% ( $P < 0.09$ ) between YS and ES, indicating a greater curve concavity in ES. This finding is emphasised by the lower level of effort at which the shape of Pta-T of ES changed from linear to curvilinear ( $-20.9\%$ ,  $P < 0.05$ ).

The similarity in the results obtained by the comparison of the two experimental procedures indicates that the different techniques are equivalent for the appraisal of the PF AC and for the analysis of the Pta-T. It appears that ES are still able to optimally activate the PF. Although both groups showed a curvilinear pattern of the Pta-T the different concavity indicates that for intermediate level of efforts (20-to-80% MVC) ES recruit a higher portion of MUs, compared to YS to develop an equivalent relative torque.

Behm D et al. *Muscle Nerve* 24:925-934,2001Scaglioni G et al. *J Appl Physiol* 92:2292-2302,2002

O104I-5

**Comparison of two methods of electrical stimulation for the evaluation of low-frequency fatigue in humans****Martin Vincent, Millet Guillaume, Deley Gaëlle, Lattier Grégory**

University of Bourgogne, France

**Keywords:** fatigue, electrical stimulation, downhill running

It has been shown that repetitive exercise can induce a preferential loss of force at low frequencies of electrical stimulation (LFF) and this dysfunction may take several days to recover. The purpose of this study was to compare the use of maximal and submaximal electrical elicited torques in the evaluation of LFF in humans.

Eleven physically active male subjects performed a 30-min downhill run at a speed of 10 km·h<sup>-1</sup> with a 20% negative slope on a motorized treadmill. KE muscle contractile characteristics were measured prior to, immediately following and 30 min after the fatiguing exercise using single twitches (Tw), doublets (Db) and 0.5 s tetanus at 20 Hz (P20) and 80 Hz (P80). The P20-P80-1 ratio was also calculated. Electrical stimulations were randomly applied either maximally to the femoral nerve or using EMS at an intensity efficient to evoke 50% of MVC during a 80 Hz-tetanus.

Immediately after the exercise, the subjects experienced a significant MVC decrement ( $-13.6 \pm 5.5\%$ ;  $P < 0.001$ ) with

concurrent decline of the mechanical responses to electrical stimulation. EMS tended to overestimate P20 and P80 decrements immediately after the exercise. The same tendency was observed for Tw ( $P=0.07$ ). However, the P20-P80-1 ratio decreases were not statistically different between EMS and NES. After a 30 minutes recovery period, the difference between EMS and NES was only observed on P20, whereas MVC had not recovered ( $-13.6 \pm 4.8\%$ ;  $P<0.001$ ).

The occurrence of peripheral fatigue, and especially LFF, significantly contributed to the MVC decrement immediately and 30 minutes after the fatiguing exercise. EMS and NES gave consistent results showing an overall alteration of evoked mechanical responses. However, tetanic responses to EMS were significantly more decreased immediately after the exercise. This was still the case for P20 after the 30-minutes recovery period. Hence, EMS and NES provided comparable results regarding the P20-P80-1 ratio both immediately and 30 minutes after the downhill run. Overestimation of electrically evoked torque decrements using EMS immediately after the exercise may arise from preferential recruitment of fast-twitch muscle fibers which are more fatigable. Together, these results demonstrate the validity of using submaximal torques to evaluate LFF in humans. It seems that the accuracy of the method is better when the effects of metabolic fatigue are minimized.

Davies CT, White MJ (1982). *J Appl Physiol* 53: 236-241

Edwards RH et al (1977). *J Physiol* 272: 769-778

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#### O104I-6

### Alterations of responses to transcranial magnetic stimulation during repeated isometric contractions

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**Keywords:** central fatigue, transcranial magnetic stimulation, hand

During the last decade transcranial magnetic stimulation (TMS) was used by some investigators concerning corticospinal mechanisms of fatigue. Reports are in disagreement about how motor evoked potentials (MEP) are modified during and after a prolonged muscular activity. This inconsistency most likely derives from very different types of protocols employed in the studies. The present study was designed to investigate how neurophysiological and mechanical responses to TMS alter during repeated fatiguing isometric contractions.

10 healthy male students (age  $22.1 \pm 2.3$  years) without neurological disorders volunteered for the study. Muscle fatigue of the first dorsal interosseus muscle was studied during repeated isometric voluntary contractions (6 seconds of contraction and 4 second pause). The task was terminated as voluntary force had fallen below 60 percent of the pre-tested maximum. TMS (figure-of-eight coil) was used to provoke MEP and mechanical responses in the exercised muscle. Twitch force (TWF) was measured over the muscle belly with a dynamometer oriented perpendicular to the muscle. The averages of 6 responses were analyzed at every time point (pre-exercise, every 25 contractions during

the exercise and during the recovery phase). Peak-to-peak amplitudes of the MEPs (MEPA) and the TWF were studied. Repeated measures ANOVA, t-tests and ANCOVA were used to deal with statistics.

The average of isometric contractions until the fatiguing of a subject was 175 repetitions. During the protocol, MEPA and TWF changed significantly ( $P<.001$  and  $P<.002$  respectively). A potentiation of the MEP was prominent only at the beginning of the task while TWF remained increased until the final fatiguing. Both measures were depressed after the task termination. However, MEPA diminishment remained more prominent. During the recovery phase TWF fully recovered, while MEPA remained depressed ( $P<.05$ ). These differences between the measures were confirmed by ANCOVA as well.

During and after the fatiguing task, modulations of the MEPA and TWF evoked by TMS were not parallel. MEP depression was not strictly mirrored in TWF. Additional qualitative analysis of the MEPs revealed a systematic shift from bi-phasic responses in pre-tests to poly-phasically shaped during the phase of fatigue and recovery phase. This phenomenon could indicate a shift from monosynaptic to oligosynaptic corticospinal projections which could namely cause temporally different recruitment of motor units.

#### O104I-07

### The importance of simple reaction, choice reaction time and visual-motor coordination in fencing

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Technical University of Opole, Poland

**Keywords:** reaction time, visual motor coordination, periodisation of training

The aim of the research was to verify the opinion, prevailing among the coaches, that time of reaction has significant influence and is a decisive factor in achieving success in combat sports.

Research procedures, apart from tests of different reaction kinds, were complemented by visual-motor coordination tests. The tests were applied to 127 fencers representing 3 levels of sports advancement, from beginners to members of the national team.

The results of the research support the assumption that the speed of reaction slightly differentiates seniors from juniors and also individual sportsmen within the respective groups. The significant variability was observed in the parameters concerning visual-motor coordination and in the choice reaction test, in the option- error scale. The results show that when the level of the sportsmen increases, the factors determining the level of sports advancement move towards conditioning in the field of neurophysiology and psychological factors. The speed of reaction is strongly related to genotype. The effects of training are not statistically significant. The observations show practical applications in diagnosing and methodological programming of training processes, depending on the level of athlete's advancement.

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## Oral Session

## Training and Testing 1

O104J

O104J-1

**Evaluation of human bioenergetics during different exercise protocols. A new approach towards designing proxies****Flouris Andreas D, Metsios Giorgos S, Koutedakis Yiannis, Famisis Konstantinos, Geladas Nikos**

Brock University, Canada

*Keywords: validation, field testing, bioenergy*

Field assessment of bioenergetics with minimal equipment and cost presents a continuous interest of many researchers seeking information on health-related fitness and performance enhancement. However, the validity of various protocols has been frequently questioned. The majority of proxies assessing human bioenergetics utilize a specific scheme in order to achieve valid predictions: exercise protocols are being designed and scientists use powerful statistical tools in order to 'link' specific performance indices (e.g. velocity, HR, time) with VO<sub>2</sub>max values achieved in the laboratory. The purpose of this study was to test a different approach towards achieving validity. It is believed that laboratory values will be most effectively predicted by achieving an 'energy equilibrium' between the proxy in question and the laboratory protocol. The prediction equations, therefore, is developed using data collected during the specific field test via portable indirect calorimetry. The present study investigated on the bioenergetics of the 15m Square Shuttle Test (15mSST), a novel field test designed to predict treadmill VO<sub>2</sub>max values, and compared it to that of the 20m Multistage Shuttle Run Test (20mMST) and a treadmill test (TT).

A repeated-measures, randomized block design required 45 male volunteers to perform three VO<sub>2</sub>max assessments within a 20-day period using the TT, the 20mMST, and the 15mSST. Workload throughout all tests was identically regulated according to the 20mMST. During testing, VO<sub>2</sub>max, total oxygen deficit (O<sub>2</sub>def), maximum heart rate (HR<sub>max</sub>), and peak blood lactate concentration (PLac) values were recorded.

The 20mMST demonstrated lower correlations with TT VO<sub>2</sub>max compared to 15mSST ( $r = .931$ ,  $p < 0.001$  vs.  $r = .681$ ,  $p < 0.05$ ). Unlike between TT and 15mSST ( $p > 0.05$ ), significant bias was detected between the mean VO<sub>2</sub>max values from TT and 20mMST ( $p < 0.05$ ) using analysis of variance. The '95% limits of agreement' analysis indicated 20mMST to have a wider range of error in predicting VO<sub>2</sub>max compared to the 15mSST ( $\pm 6.51$  vs.  $\pm 2.9$  ml·kg<sup>-1</sup>·min<sup>-1</sup>). Furthermore, analysis of variance indicated that, unlike in the 15mSST ( $p > 0.05$ ), PLac and O<sub>2</sub>def values in the 20mMST were significantly elevated ( $p < 0.05$ ) comparing with that of TT. Mean HR<sub>max</sub> values recorded during 15mSST and 20mMST were significantly elevated ( $p < 0.05$ ) compared to the equivalent from TT.

It is concluded that the novel 15mSST is a valid protocol and it is generally a more efficacious proxy in predicting treadmill VO<sub>2</sub>max compared to the 20mMST.

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O104J-2

**The isocapnic buffering and hypocapnic hyperventilation phases during incremental exercise: relationship to cycle time trial performance****Bentley David**

University of Copenhagen, Denmark

*Keywords: cycling, anaerobic threshold, trial performance*

There are limited studies examining the relationship between physiological variables and performance in 'short' or 'long' cycle TT (Bentley et al., 2001). Recently there has been interest in the isocapnic buffering (IB) and hypocapnic hyperventilation (HHV) phases obtained from incremental exercise testing as indicators of endurance performance (Chicharro et al., 2000; Oshima et al., 1997). The purpose of this study was to determine the relationship between the IB and HHV phases obtained from a rapid incremental exercise test and performance in a 'short' (20 min) and 'long' (90 min) TT in trained cyclists.

Thirteen male endurance athletes (Mean±SD age 31±6 yr; body mass 75.6±6.3 kg) volunteered to participate in the study. Each subject was required to complete three tests performed on an cycle ergometer during a two week period in the latter stages of the training year. The first test comprised a continuous incremental (~25 W·min<sup>-1</sup>) ramp test for determination of peak power output (PPO) as well as the IB and HHV phases. The second and third tests comprised a 20-min and 90 min TT for determination of the average power output. The PPO (W) was highly correlated ( $r = 0.85$ ;  $p < 0.001$ ) to the average power output (W) in the 90-min TT. The PPO (W) was also significantly correlated to the average power output (W) in the 20-min TT ( $r = 0.66$ ;  $p < 0.05$ ). The IB phase (W) was significantly correlated to the average power output (W) in the 20-min ( $r = 0.58$ ), but not in the 90-min TT ( $r = 0.28$ ). The HHV phase (W) was not significantly correlated to the average power output in the 20-min ( $r = -0.10$ ) or 90-min TT ( $r = 0.10$ ). Both the IB phase (%RCP) and the HHV (%PPO) were not significantly correlated with performance in either TT.

Although the IB phase was significantly correlated to 20-min TT performance, the relationship was weak (explaining 34% of the variation of performance in the 20 min trial). Therefore, it seems that this variable together with HHV, is not likely to be a useful indicator of cycle TT or overall endurance performance. However, the PPO remains a variable that is easily quantified and highly correlated to cycle TT performance.

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## O104J-3

**High-intensity strength-training versus sensorimotor-training and their combinatory effects on muscle strength****Kullmann Niclas, Bruhn Sven, Gollhofer Albert**

Albert-Ludwigs-University Freiburg, Germany

*Keywords: EMG, strength, sensorimotor training*

It is well known that high intensity strength training (HIS) enhances muscle voluntary contraction (Bührlé, 1985; Hakkinen, 1985). Recent studies on sensorimotor-training, however, (Heitkamp et al., 2000; Gruber et al., 2001) have sparked new ideas and raised discussion on new methods that might as well be successful in the gain of muscle strength. Therefore the aim of this study was to compare the effects of a high intensity strength training to those of a sensorimotor-training and to examine combinatory effects of the two training regimen.

17 subjects were randomly divided up into two training groups. To find out about the individual and combinatory effects of the two training regimen, one group did 4 weeks of HIS-training followed by 4 weeks of sensorimotor-training (strength-sensorimotor group). The other group did 4 weeks of sensorimotor-training followed by 4 weeks of HIS-Training (sensorimotor-strength group).

We could find that at the end of the first training-period both groups showed a significant increase in muscle strength. This gain in strength was accompanied by an increase in iEMG. After the second training-period, only the sensorimotor- strength group was able to show significant gain in muscle strength.

The major finding of this study was the significant gain in muscle-strength in both groups after the first training phase. A second finding was the continual gain in muscle strength in the combination of sensorimotor-training followed by HIS-training.

In conclusion, these results suggest that for untrained people HIS-training and sensorimotor-training show the same effects over the early training phase and eventually are interchangeable. In the later training phase HIS-training is to be favored to achieve a further gain in muscle strength.

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## O104J-4

**Increased maximal unloaded movement speed and altered MHC isoform composition following detraining subsequent to strength training****Andersen Lars L, Andersen Jesper L, Suetta Charlotte, Christensen Lasse R, Madsen Jørgen L, Klausen Klaus, Aagaard Per**

Bispebjerg Hospital, Denmark

*Keywords: strength training, unloaded movement velocity, MHC*

In many sports, the ability to perform dynamic movements at maximal velocity is crucial for a successful performance (i.e. in kicking, smashing, throwing, punching). Previous research

has demonstrated a shift towards a faster muscle MHC profile and faster electrically evoked muscle contractile characteristics when strength training was followed by a period of detraining. However, it is unknown to which extent these changes will affect functional muscle performance. The aim of the present study was to examine the effect of detraining subsequent to strength training on the performance of maximal unloaded limb movement and to elucidate the underlying adaptation mechanisms.

Knee joint angular velocity of maximal unloaded knee extensions was determined in 13 sedentary young males before and after 14 weeks of strength training and after 14 weeks of detraining. EMG activity was obtained in agonist (VL, VM, RF) and antagonist muscles (BFcl, ST). Biopsies were taken from the vastus lateralis muscle for analysis of MHC isoform composition. Evoked muscle twitches were recorded by percutaneous stimulation. Isometric quadriceps MVC was measured at 90 deg knee joint angle. Muscle cross-sectional area (CSA) was measured by MRI at 50% femur length.

MVC and muscle CSA increased following training ( $p < 0.05$ ). However maximal unloaded knee extension velocity remained unchanged. Following detraining MVC and CSA returned to pre-training levels. In contrast, maximal unloaded knee extension velocity increased 13 % along with faster evoked muscle twitch characteristics and an increased proportion of fast MHC isoforms ( $p < 0.05$ ). Agonist and antagonist muscle EMG activity measured during maximal unloaded knee extension remained unchanged.

In conclusion, detraining subsequent to strength training seems to induce a faster muscle profile, as reflected by an increased proportion of fast MHC isoforms and faster evoked contractile characteristics, which at the functional level are manifested by an increased velocity of maximal unloaded limb movement.

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## O104J-5

**The predictive validity of ventilatory and lactate thresholds on 40K time trial performance****Amann Markus, Subudhi Andrew, Foster Carl**

The Orthopedic Specialty Hospital, University of Utah, United States

*Keywords: cycling, training, testing*

The determination of metabolic parameters is widely used to direct training. The purpose of this study was to determine which laboratory measurement best predicted 40km time trial performance (40Ktime). Fifteen experienced male cyclists (age  $31 \pm 8$ ; HT  $175 \pm 5$  cm; WT  $70 \pm 8$  kg) performed lactate threshold (LT; 100W + 50 W/min), ventilatory threshold (VT; 20W + 25W/min), 5km time trial (5K), and 40K tests over an 8-day period. The key variables of interest were watts at thresholds commonly reported in the literature. For VT determination we used the first systematic rise in VE/VCO<sub>2</sub> without a concomitant increase in VE/VCO<sub>2</sub>, the first clear breakpoint on the VE/VCO<sub>2</sub> plot, V-slope method, RER1.0, and RER0.95. For LT we used the individual anaerobic threshold, the stage proceeding the second 0.5 mmol/L increase (Baldari method), a fixed 4 mmol/L concentration, the first 1 mmol/L increase in 3 min, and the stage

proceeding the first 1 mmol/L increase as criterion methods. Peak power during the threshold tests (MaxVTwatts, MaxLTwatts) and 5K performance measures (5Ktime, 5Kavgwatts, 5Kavgwatts/kg) were also included in the analyses. The regression between VT variables and 40Ktime was significant  $F(6,8) = 7.35$ ,  $p = 0.006$ ,  $R^2 = 0.85$ . Only the VE/VO<sub>2</sub> and MaxVTwatts met the criteria for further analysis (partial correlation<sup>2</sup>  $\geq 10\%$ ). The regression between LT and 40Ktime was not significant  $F(6,7) = 3.33$ ,  $p = 0.07$ ,  $R^2 = 0.74$ , yet the Baldari method, and MaxLTwatts met the criteria for further analysis. The regression between 5K and 40Ktime was significant  $F(3,11) = 7.83$ ,  $p = 0.004$ ,  $R^2 = 0.68$ , however no variables met the criteria for further analysis. A follow up regression of 40Ktime with VE/VO<sub>2</sub>, MaxVTwatts, Baldari, and MaxLTwatts was significant  $F(4,10) = 10.34$ ,  $p = 0.001$ ,  $R^2 = 0.81$ , with partial correlations of VE/VO<sub>2</sub> and MaxVTwatts accounting for 38% and 23% of the variance in 40Ktime, respectively. Paired t-tests between VE/VO<sub>2</sub>, MaxVTwatts, Baldari, MaxLTwatts and the 40Kavgwatts indicated that only VE/VO<sub>2</sub> method was not significantly different ( $p = 0.33$ ) from 40Kavgwatts. We recommend the use of VE/VO<sub>2</sub> determination for the prediction of 40K performance.

#### O104J-6

### Cross-sectional study on relationship between stroke parameter and aging in junior competitive swimmers

Sengoku Yasuo, Shimoyama Yoshimitsu, Ichikawa Hiroshi, Shiraki Takahisa, Watanabe Masashi, Nomura Takeo

University of Tsukuba, Japan

*Keywords: stroke parameter, aging, junior athletes*

There have been several studies to evaluate stroke parameter such as Stroke Rate (SR) and Stroke Length (SL) in senior competitive swimmers. However, few studies have attempted to investigate the relationship between stroke parameter and aging. Such investigation would help coaches to obtain age-appropriate information for coaching junior swimmers. Therefore, the purpose of the present study was to investigate relations of stroke parameter with aging and performance in junior competitive swimmers cross-sectionally.

Subjects were 111 trained junior competitive swimmers (male=49, female=62) aged from 10 to 17, whose major stroke was freestyle. All subjects had some experience in swimming race. Subjects swam three trials in the swimming flume. Swimming velocity in these trials were 75%, 80% and 85% of the individual 50m freestyle best records and swimming duration was 20 seconds, respectively. Stroke parameter was SR and SL, which were measured from the video taken through each trial. SR was calculated by the time required for three-stroke cycle. SL was calculated by dividing swimming velocity by SR.

The results showed that SR increased significantly with increasing swimming velocity ( $p < .05$ ). SL had a tendency to be kept even or decrease as swimming velocity increases. These results had similar tendency with senior competitive swimmers in the previous studies. SR had no significant correlation to aging and 50m best records in both males and females. SL highly correlated ( $p < .05$ ) to aging and 50m best record in male swimmers. Though in female junior swimmers, higher correlation was shown to 50m best records compared to aging. Swimming technique evaluated by SL improved in relation to aging and lead to 50m swimming performance improvement in male junior swimmers. On the

other hand, female swimmers 50m swimming performance depends more on individual technique level than aging.

The present study demonstrated that there are different tendencies in SL changes in relation to aging between male and female junior competitive swimmers. Among female, SL had higher correlation to performance compared to aging. Therefore, female junior swimmers should focus on improving swimming technique from an earlier age.

#### O104J-7

### Comparative characteristics of elite English and South African 18-year-old rugby-players with reference to game-specific skills, physical abilities and anthropometric data

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*Keywords: physical abilities, anthropometric data, rugby*

International collaboration in research, especially on team sports, is needed to get more clarity on the characteristics of elite youth athletes. The aim of this study is to draw a comparison between an elite English and an elite South African 18-year-old rugby team.

Components that will be tested are game-specific variables, physical and motor abilities and anthropometric data. In order to link up with modern research, aspects such as innate characteristics and date of birth will also be referred to.

Results show that the South African boys were slightly leaner than their English counterparts and that slight differences in kicking and passing abilities are thought to be more attributable to environmental factors than physical characteristics.



## Plenary Session

### Challenges of Elite Sport

PL11H

#### PL11H-1

#### The economics and commercialism of elite sport: the Olympic experience in the 20th century

**Barney Robert K.**

University of Western Ontario, Canada

*Keywords: Olympics, elite sport, commercialism*

When an institution embraces a generally viewed positive rather than negative image, and, at the same time, guarantees exposure to some three-fifths of the world's population, business firms' intent on advertising goods and services to consumers sit up and take notice. Such an institution is the Modern Olympic Movement and its showcase undertaking, the Olympic Games. A relatively poor organization for well over the first half century of its history, the IOC can now proudly boast that world television rights fees paid since the first episode of their existence, Squaw Valley 1960, will amount to slightly more than \$10 billion by the time the 2008 Games close in Beijing. Then, too, with the emergence of TOP and corporate sponsorship in the early 1980s, a whole new and powerful revenue-producing agent has taken its place beside television to form twin pillars of wealth production beyond the wildest imagination of the IOC's founding fathers, who always believed that the munificence of federal, provincial, and municipal governments would somehow finance the great festivals; either that, or simply providence. The complex and interesting tale of the economics and commercialism of elite sport in the Olympic experience of the 20th century forms the basis for my plenary address remarks.

in elite sport can be divided into: a) disintegrated measurement technologies with various invasive and non-invasive analytical techniques up to satellite-based information processing such as GPS-technologies, b) data integration with intelligent content management systems, c) innovative and explorative data analysis, such as time series analysis with moving window techniques, d) personalized access to education and research data via customizable WebSphere-Portlets.

The sum of data associated with this exemplary result is transferred to a content management system (IBM/CM8) where various display options are available, such as an electronic athlete record, relevant collected associated data, related literature results and web-findings, personal training documentation and much more. The screen display can be personalized for the athlete, the coach or the scientist. Also, contents can be integrated into e-learning modules for use by broader target groups. All these functions can directly be embedded in a browser-based application and thus – with respective high-level security mechanisms - be made available via the Internet.

#### PL11H-2

#### Information management in elite sport: concepts and technologies between measurements and education

**Mester Joachim**

German Sport University Cologne, Germany

*Keywords: adaptation, training response, information management*

Modern broadband digital information provided via the Internet together with data floods produced by all kinds of measurement devices, e.g. in performance diagnostics, lead sometimes to the impression that we have more information every day, but do not know how to process this information into knowledge. In elite sport, the risks for personal health are greater than ever. The question as to what kind of information can be considered reliable and useful on the one hand as well as being retrievable, structured and educational on the other is also becoming more important than ever.

In empirical studies in elite sport, however, a sample from the total population (e.g. all national sprinters) rarely fulfils statistical prerequisites such as normal distribution and others. Also, the number of variables measurable for one athlete and coming from biomechanics, physiology, psychology etc., is much too large to be analyzed with conventional statistical tools only. The methods that will be discussed for their contributions to information management

## Symposium

### Neuronal Mechanisms in Strength and Power Training

S111A

#### S111A-1

##### Specificity of neuromuscular adaptations during heavy resistance and power training

**Häkkinen Keijo**

University of Jyväskylä, Finland

*Keywords: resistance strength training, neuromuscular adaptation, power training*

Heavy Resistance Neural Protocol (HRNP) performed with very high loads leads to acute decreases in maximal voluntary activation and strength of the exercised muscles. Heavy Resistance Hypertrophic Protocol (HRHP) performed with medium high loads but multiple repetitions leads to drastic acute fatigue in neuromuscular performance with great accumulation of blood lactate and large acute hormone responses. Explosive Resistance/Power Protocol (ERP) performed with low loads but high velocities leads to acute decreases during the initial portions of the IEMG- and force-time curves of the loaded muscles.

Training-induced neural adaptations can be measured e.g. using recordings of voluntary actions combined with electrical stimulation procedures (e.g. force produced by supramaximal single pulses given during maximal voluntary efforts) or using invasive techniques, in which needle or fine-wire electrodes are inserted into muscle (allowing single motor unit recordings) or indirectly, by analyzing changes occurring in EMG activity of trained muscles. HR training leads to changes in the quantity and quality of activation so that 1) activation of the agonists is increased, and there is 2) a reduction in coactivation of the antagonists, and 3) an improved coactivation of the synergists.

The degree of HR training-induced muscle hypertrophy is measured by the size of individual muscle fibers or the cross-sectional area of the muscle using an ultrasonic apparatus, CT or MRI. HR training-induced hypertrophy can also be non-uniform along the belly of the muscle, and different even between the individual muscles of the same muscle group. Architectural adaptations with changes in muscle pennation angle also occur during HR training. More attention is to be paid to hormonal factors to avoid overtraining in athletes.

HR training that utilizes high loads with slow action velocities leads to improvements in maximal strength, while ERP training results in improvements also in high velocity portions of the force-velocity and force-time curves. Although neural activation of the agonists during various ER exercises is very high, the time of this activation is so short, and acute anabolic hormone responses so minor that ER training-induced muscular hypertrophy takes place to a smaller degree than during HR training. ER training may lead to architectural changes with the decrease in muscle pennation angle creating for optimal conditions for power and speed production of trained muscles.

#### S111A-2

##### The sites of neural adaptation to resistance training revealed by transcranial stimulation

**Carroll Timothy, Riek Stephan, Carson Richard**

The University of New South Wales, Australia

*Keywords: muscle strength, neural adaptations, corticospinal pathways*

Although it has long been supposed that resistance training causes adaptive changes in the CNS, the sites and nature of these adaptations have not been well described. Furthermore, most studies concerned with the neural responses to resistance training have attempted to determine the neural mechanisms underlying increases in strength. Our purpose is rather to discover the broad implications of resistance training for the control of movement. As a first step in this approach, we sought to determine whether the neural adaptations to resistance training occur to a greater extent at cortical or sub-cortical sites in the CNS.

We compared the affects of resistance training on electromyographic (EMG) responses to transcranial magnetic (TMS) and electrical (TES) stimulation. Motor evoked potentials (MEPs) were recorded from the first dorsal interosseous of sixteen individuals before and after four weeks of resistance training for the index finger abductors (n=8), or training involving finger abduction-adduction without external resistance (n=8). TMS was delivered at rest at intensities from 5% below the passive threshold to the maximal output of the stimulator. TMS and TES were also delivered at the active threshold intensity while the participants exerted torques ranging from 5 to 60 % of their maximum voluntary contraction (MVC) torque.

The average latency of MEPs elicited by TES was significantly shorter than that of TMS MEPs (TES latency =  $21.5 \pm 1.4$  ms; TMS latency =  $23.4 \pm 1.4$  ms;  $p < 0.05$ ), which indicates that the site of activation differed between the two forms of stimulation. Training resulted in a significant increase in MVC torque for the resistance training group, but not the control group. There were no statistically significant changes in the corticospinal properties measured at rest for either group. For the active trials involving both TMS and TES, however, the slope of the relationship between MEP size and the torque exerted was significantly lower after training for the resistance training group ( $p < 0.05$ ).

Thus, for a specific level of muscle activity, the magnitude of the EMG responses to both forms of transcranial stimulation were smaller following resistance training. These results suggest that resistance training involving simple movements changes the functional properties of spinal cord circuitry in humans, but does not substantially affect the organisation of the motor cortex.

## S111A-3

**Neural adaptation to strength training****Aagaard Per**

Bispebjerg Hospital, Denmark

*Keywords: strength training, muscle, neural plasticity*

The adaptive change in neural function with strength training has been evaluated by use of muscle electromyography (EMG) measurements, which were recently supplemented by measurements of evoked spinal reflex responses (H-reflex, V-wave).

Explosive muscle strength, defined as the contractile Rate of Force Development (RFD), reflects the ability to generate steep increases in muscle force at the onset of contraction. Parallel increases in RFD, EMG amplitude and rate of EMG rise have been observed in the initial 0-200 ms of contraction following strength training. The specific neural adaptation mechanisms responsible for the training-induced increase in RFD include increased motoneuron firing frequency and elevated incidence of doublet firing.

A neural regulatory mechanism that limits the recruitment and/or discharge rate of motor units has been suggested to exist during maximal voluntary eccentric muscle contraction, as the EMG recorded in the quadriceps femoris muscle during maximal eccentric contraction is markedly reduced compared to that of maximal concentric contraction. Following a period of heavy-resistance strength training this suppression in eccentric EMG amplitude is removed along with a marked increase in maximal eccentric muscle strength. The adaptative mechanisms may involve a down-regulation of inhibitory activity from Golgi organ Ib afferents and/or a reduced presynaptic inhibition of Ia afferents from muscle spindles.

The Hoffmann (H) reflex can be used to examine the spinal neural circuitry at rest and during active contraction. The V-wave is a variant of the H-reflex that can be elicited when supramaximal stimulation of the peripheral nerve is superimposed onto voluntary muscle contraction. Elevated V-wave and H-reflex amplitudes have been observed during maximal muscle contraction following strength training, indicating an enhanced neural drive in descending corticospinal pathways, elevated motoneuron excitability and/or reduced presynaptic inhibition of Ia afferents. Notably, the H-reflex response recorded during resting conditions seems to remain unchanged with strength training. To examine the neural adaptation induced by training, evoked spinal reflex recordings therefore should be performed during actual muscle contraction and not solely at rest.

## S111A-4

**Transcranial magnetic stimulation in relation to skill and strength training****Lundbye Jensen Jesper, Marstrand Peter, Nielsen Jens Bo**

University of Copenhagen, Denmark

*Keywords: strength training, transcranial magnetic stimulation, skill learning*

Maximal muscle strength and optimal motor control are decisive for performance at elite level. The aim of the present study was to investigate corticospinal transmission in relation to two different types of training of the right elbow flexors (primarily m. Biceps Brachii (BB)).

One group of subjects (n=8) performed strength training 3 times a week, another group of subjects (n=8) trained a visuomotor skill (tracking) task (20 minutes 3 times a week) and a control group (n=8) did not train. Subjects were tested before the training period (pretest), after 2 weeks (mediotest) and after 4 weeks of training (posttest). Each test involved generation of stimulus-response-curves (SR-curves) using Transcranial Magnetic Stimulation (TMS) of the left motor cortex and evoked motor potentials (MEPs) were recorded from BB. All MEP-amplitudes were related to the maximal motor response (Mmax). Motor threshold (MT), slope and MEPmax were registered for each SR-curve. SR-curve measurement was followed by a bout of either skill or strength training and immediately after training another SR-curve was generated. Maximal dynamic and isometric strength of all subjects were tested before and after the training period, and the skill training (tracking) group had their accuracy of tracking tested during the tracking task. The SR-curve data were analysed using a one way ANOVA statistical test between groups and a paired T-test inside the groups.

A significant increase in MVC torque (12,5% p=0,045) and dynamical strength (31,2% p<0,001) was observed in the resistance-training group. The skill training group improved their level of tracking performance significantly during the course of the training bouts. MEP's were facilitated following the first training bout in the skill training group. Neither strength training nor control group showed any short term differences. MT showed a significant left shift from pretest to posttest in the skill training group. MEPmax increased significantly from the pretest to the posttest. The SR-curves of the strength training group showed a decrease in slope across pretest, mediotest and posttest. MEPmax declined significantly from the pretest to the posttest.

These findings suggest that resistance training does not involve increased excitability of the corticospinal pathway to the elbow flexors - it may even have the opposite effect. The changes observed in corticospinal transmission in the skill training group may reflect plastic changes in the cortical representation of the elbow flexors.

## Oral Session

## Nutrition

## O111B

## O111B-1

**Dietary intake, iron status, and supplement use in female winter sport athletes during the preparation for the 2002 Olympic Winter Games**

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*Keywords: nutrition, winter sports, female athletes*

Altitude and cold temperatures prevail under winter sport training conditions, possibly altering nutrient and fluid requirements of winter sport athletes (Askew 1995).

We compared dietary and fluid intake of 35 female winter sport athletes (age: 26 ± 6yrs; height: 166 ± 6cm; weight: 63 ± 6.6kg) during non-specific (dry-land), NST (1614 ± 374m; 25 ± 22.5°C) and specific (on-snow/ice), ST (1921 ± 442m; -1 ± 9°C) training. Further, we assessed changes in iron status and described supplement use. Dietary, supplement, and fluid intake and physical activity were assessed by two weighed 3-day dietary and concurrent activity records administered during intense training. Iron status was measured pre- (early summer) and post- (late fall) training. During ST, energy intake was compared to expenditure and carbohydrate, protein, and hourly fluid intake to current sport nutrition recommendations.

Dependent t-tests revealed no difference in energy balance (NST: -329 ± 687kcal×d-1; ST: -331 ± 854kcal×d-1), carbohydrate (NST: 6.8 ± 1.9g×kg-1×d-1; ST: 6.8 ± 1.8g×kg-1×d-1), protein (NST: 1.9 ± 0.5g×kg-1×d-1; ST: 1.8 ± 0.5g×kg-1×d-1), fat (NST: 1.1 ± 0.4g×kg-1×d-1; ST: 1.3 ± 0.6g×kg-1×d-1), and micronutrient intake between NST and ST. Micronutrient intake was above recommendations. Total fluid (NST: 5.3 ± 1.6L×d-1; ST: 4.4 ± 1.4L×d-1) and hourly fluid (NST: 427 ± 211ml×hr-1; ST: 232 ± 211ml×hr-1) intake was lower during ST than NST (p<0.001). During ST, dependent t-tests revealed lower energy intake (2824 ± 632kcal×d-1) than expenditure (3155 ± 571kcal×d-1) (P<0.02), and one-sample t-tests showed similar carbohydrate (value: 7g×kg-1×d-1), higher protein (value: 1.2g×kg-1×d-1; P<0.000), and lower hourly fluid intake (value: 800ml×hr-1; P<0.000) compared to recommendations. Three athletes were iron deficient (ferritin <12ng/ml) before but not after training. Dependent t-tests showed an increase in transferrin saturation (30 ± 18% versus 35 ± 17%; P<0.012) with no change in hemoglobin, hematocrit, and serum ferritin from pre- to post-training. Energy-yielding supplements contributed to mean energy (13%), carbohydrate (17%), protein (8%), and fluid (20%) intake. Over 80% of athletes used dietary supplements, with a B-vitamin complex and multiple vitamins/minerals being the most frequently used.

In summary, female winter sport athletes have adequate dietary intake and iron status but low fluid intake, particularly during ST.

Askew EW (1995). *Am J Clin Nutr* 61: 631S-637S

## O111B-2

**Dietary red pepper ingestion increases resting muscle metabolism in humans**

Ueda Chihoko, Hamaoka Takafumi, Murase Norio, Osada Takuya, Sako Takayuki, Kurosawa Yuko, Kime Ryotaro, Homma Toshiyuki, Nagasawa Takeshi, Kitahara Aya, Ichimura Shiro, Moriguchi Tetsushi, Motobe Mayuko, Nakagawa Naoki, Katsumura Toshihito

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*Keywords: near infrared spectroscopy, red pepper, muscle oxygen consumption*

The purpose of this study was to determine the effects of red pepper ingestion on human muscle metabolism using our previously reported method (Ueda et al., 2002).

Nine healthy volunteers (5 male and 4 female, age: 27-35 yr.) participated in the study. Muscle oxygen consumption (VO<sub>2mus</sub>) and blood flow (BF<sub>mus</sub>) were measured by near infrared continuous wave spectroscopy using the brief arterial occlusion method (Hamaoka et al. 1996) and the venous occlusion method (De Blasi et al. 1994) respectively. Pulmonary oxygen uptake (VO<sub>2pul</sub>) and respiratory exchange ratio (RER) were measured by expiratory gas analysis method. Each subject was tested on two occasions, given 1.0g dried powder red pepper or an equal amount of placebo in a double blind and cross over design. The changes were monitored for 150 minute after each sample intake. Cardiac sympathetic nervous activity (SNA) was also assessed by means of spectral analysis of heart rate variability (SNA index). All results are presented as mean ± SD. The differences were determined using the nonparametric tests (Wilcoxon), and statistical significance was at p<0.05.

After red pepper intake VO<sub>2pul</sub> increased by 9 ± 2 % at the peak (30 min., p<0.01). VO<sub>2mus</sub> also showed increase by 16 ± 5% (120 min., p<0.01). RER did not show any significant changes after red pepper intake. There were also increases in BF<sub>mus</sub> by 20 ± 10% (150 min., p<0.05) and in SNA index at 15min compared with placebo.

The results indicate that red pepper intake induced a significant increase not only in whole body metabolism, but also in skeletal muscle metabolism. In contrast to previous studies (Henry and Emery, 1986; Yoshioka et al, 1995), RER did not show a significant increase as in previous studies. It is thought that red pepper ingestion did not promote the rate of carbohydrate oxidation over fat oxidation in this study. The increased SNA index suggests that SNA activity is related to a regulation of muscle metabolism.

De Blasi RA et al (1994), *J Appl Physiol* 76: 1338-1393.

Hamaoka T et al (1996), *J Appl Physiol* 81: 1410-1417.

Henry H, Emery B (1986), *Human Nutr* 40C: 165-168.

Ueda C et al (2002), *Eur J Sport Sci* 2(6).

Yoshioka M et al (1995), *J Nutr Sci Vitaminiol* 41: 647-656.

## O111B-3

**Effects of BCAA supplementation on the human metabolic responses during submaximal exercise in the cold**

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*Keywords: exercise, BCAA*

The purpose of this study was to suggest the possibilities of improving endurance exercise performance in the cold by the investigation of the effect of BCAA supplementation on metabolic responses during prolonged submaximal exercise in the cold.

Ten male long-distance runners participated as subjects for this study, and were exposed to thermoneutral ( $22 \pm 1^\circ\text{C}$ ) and cold ( $5 \pm 1^\circ\text{C}$ ) temperature conditions with relative humidity of  $60 \pm 5\%$  for 60 min in a temperature and humidity-controlled chamber maintained in each condition. Each subjects exercised at a work rate corresponding to  $60\% \text{VO}_{2\text{max}}$  for 90 min by two treatments (BCAA and placebo) and two environmental conditions (thermoneutral and cold). In the BCAA treatment, the subject was supplemented with 200g/1320g; of BCAA (L-leucine; 45%, L-isoleucine; 30%, L-valine; 25%) solution at 45 min and 15 min prior to exercise, respectively.

Rectal temperature, heart rate and RPE were significantly ( $p < 0.05$ ) elevated above the baseline by 90 min of exercise, and these increase were higher in the thermoneutral condition compared with the cold, but no differences were found in these variables on the comparison of the BCAA and the placebo treatments. Exercise caused an increase in the plasma concentration of epinephrine and norepinephrine in both conditions and treatments, and these hormones were a significantly ( $p < 0.05$ ) higher in the cold compared with the thermoneutral temperature. No differences were observed in these hormones at any point during exercise when the two treatments (BCAA and placebo) were compared. Serum insulin concentration was significant ( $p < 0.05$ ) reduced at 90 min of exercise below the baseline. While plasma ammonia concentration was not different between two temperature conditions, it was a significantly ( $p < 0.05$ ) higher at 30 min and 60min of exercise in the BCAA treatment compared with placebo. Serum glucose concentration was significantly ( $p < 0.05$ ) higher in the thermoneutral temperature compared with the cold.

Summing up, although the cold condition seems to have a negative affect to endurance capacity, it's effect on blood hormone and metabolites responses is not clear. In addition, BCAA supplementation during prolonged submaximal exercise in the cold does not seem to have the possibility to improve endurance exercise performance and metabolic responses.

## O111B-4

**Effect of acute branched-chain amino acid (BCAA) supplementation on prolonged exercise capacity in a warm environment**

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*Keywords: thermoregulation, central fatigue, serotonin*

Accelerated central fatigue resulting in a reduced drive to continue exercise has been proposed as an important factor in the reduction in exercise capacity observed when exercising in a warm environment (Nielsen, 1992). Support for the involvement of serotonin in the development of fatigue

during exercise in the heat has been equivocal (Mittleman et al, 1998; Watson et al, 2002). The aim of the present study was to assess the effect of BCAA supplementation on exercise capacity in a warm environment following a regimen designed to deplete glycogen.

Eight active males participated in this ethics committee approved study. Subjects completed preliminary trials and 2 experimental trials. In the evening subjects completed a bout of prolonged exercise to reduce glycogen availability, followed by a low CHO meal and fluids. The following morning subjects returned to the lab. Skin and rectal temperature probes and a heart rate monitor were positioned. Blood samples were drawn from a cannula inserted into a superficial forearm vein. Subjects remained seated at  $25 - 26^\circ\text{C}$  for 2h, before commencing cycle exercise at  $50 \pm 2\% \text{VO}_{2\text{peak}}$  in a warm environment ( $30.0 \pm 0.2^\circ\text{C}$ ) until volitional exhaustion. 250ml of a BCAA solution (12 g/L BCAA) or a sugar-free placebo was ingested at 30 min intervals prior to exercise, with 150ml consumed every 15 min throughout exercise. Statistical difference ( $P < 0.05$ ) between the experimental trials was evaluated using repeated measures ANOVA and paired t-tests as appropriate.

Exercise capacity was similar in both trials (placebo  $103.9 \pm 26.9\text{min}$ , BCAA  $111.0 \pm 29.2\text{min}$ ;  $P = 0.129$ ). Rectal and mean skin temperatures were unaffected by BCAA supplementation. The subjects' perceived exertion and thermal comfort were not different. Ingestion of the BCAA solution produced a marked increase in plasma BCAA, resulting in a 4-fold reduction in f-TRP:BCAA when compared to the placebo. Plasma ammonia was significantly elevated during exercise in the BCAA trial, with no effect on blood glucose or lactate.

Exercise capacity was unaffected by the oral ingestion of a BCAA solution when compared to a placebo. The results of the present study further question the importance of the serotonergic system in central fatigue during prolonged exercise in a warm environment.

Mittleman KD et al (1998). *Med Sci Sports Exerc* 30: 83-91Nielsen B (1992). *Med Sport Sci* 34: 207-17.Watson P et al (2002). *Proc Nutr Soc* 61: 109A

## O111B-5

**Comparison of fluid replacement strategies following soccer-specific exercise-induced dehydration**

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*Keywords: soccer, rehydration, fluid*

For rapid restoration of fluid balance, carbohydrate (CHO) and sodium (Na) have both been suggested as critical components in rehydration solutions. Following activity, athletes commonly use CHO drinks to replenish lost fluids, whereas the medical fraternity often treats symptoms of dehydration with a Na-based product called Gastrolyte®. In this study, following exercise-induced dehydration, CHO and/or Gastrolyte® solutions were administered and markers of hydration status monitored.

Seven elite junior soccer players ( $15.6 \pm 0.3$  yrs) completed four trials (once per week), following a standardised 24-hour diet and 12-hour fluid intake. Players performed intermittent exercise in a warm ( $21^\circ\text{C}$ ), humid (53% RH) environment using a soccer simulation protocol (Australian Institute of Sport) which involved 11-min exercise bouts, separated by 5-min rest for the assessment of nude body mass. Exercise

bouts continued until body mass loss reached 1.9%. Following a 30-min break, players commenced a rehydration phase by ingesting one of four drinks over a 60-min period. The ingested volume was equivalent to 1.5 times the body mass loss for each player from exercise. The four drinks were: (A) water; (B) CHO solution (8% CHO, 10.8mM Na); (C) Gastrolyte® (1.6% CHO, 17.4mM Na); (D) CHO + Gastrolyte® (8.4% CHO 17.4mM Na). Drink order was randomly assigned across the four trials. Blood and urine samples were taken prior to exercise, immediately pre- and post-rehydration, and 1, 2 and 3 hours after completion of the rehydration phase.

Cumulative urine output for Drink D was significantly lower throughout the 3-hour post-ingestion period. This difference was most apparent in the first hour where urine output for Drink D was markedly lower. Changes in serum osmolality inversely reflected the changes in urine output per hour. Unexpectedly, at completion of the 60-min ingestion period, urine specific gravity had increased for Drink D whilst decreasing for Drinks A, B and C. As the post-ingestion phase progressed, players fell into net negative fluid balance regardless of drink, however, these declines appeared delayed with Drink D.

Several markers of hydration suggest that administering Gastrolyte® to a CHO solution enhances fluid retention following exercise-induced dehydration more so than water, Gastrolyte® or commercial CHO solutions alone. Interestingly, the validity of urine specific gravity as a measure of post-exercise rehydration is questionable early in the post-ingestion period.

#### O111B-6

### The effect of vitamin E and C supplementation on the immune response in trained men

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**Keywords:** vitamin E, vitamin C, immune response

The present research was designed to determine the effect of vitamin E and C supplementation on the immune response in trained men.

In this research 45 trained men were studied in four groups of control (CO), vitamin E(VE), vitamin C (VC) and combination of vitamin E and C (VEC) that received a daily dose of placebo, 400 mg vitamin E, 1000 mg vitamin C and combined 400 mg vitamin E plus 1000 mg vitamin C respectively for 15 days.

After 15 days, all subjects underwent the Bruce Maximal Treadmill Protocol up to exhaustion. Blood samples were taken before, immediately after and two hours after the exercise in order to measure the total number of white blood cells (WBC), neutrophils, monocytes, CD4+ and CD8+ cells, CD4+/CD8+ ratio, concentration of IgM, IgG and IgA serum and phagocytosis activity of neutrophils (PAN). Immediately after the exercise in all four groups, the WBC, neutrophils, monocytes (except CO group), CD8+, IgM (except VE group), IgG and IgA Concentrations and PAN increased and CD4+/CD8+ ratio decreased. These changes were only significant about decrease of monocytes in the CO group comparing the other groups ( $P < 0.05$ ). Two hours after the exercise the WBC, neutrophils, CD4+/CD8+ ratio, IgM concentration and PAN increased in all four groups and monocytes (except CO group), CD4+, CD8+, IgA concentration (except CO group) decreased. During the two hours after the exercise, IgG concentration in the CO and VEC groups increased, whereas they decreased in the VE and VC groups.

None of these changes were significant when these groups were compared with each other ( $P < 0.05$ ), which is probably due to the short period of the exercise or short period of consumption of vitamins with the doses used in this research. Also, despite the exhaustive exercise the athletes performed, it seems that the duration of exercise was not sufficiently prolonged to lead to the depletion of vitamin E and C pools in order to have any effects on immune function.

Huffman - Goetz L, Pedersen BK (1994). *Immunol. Today*, 15, 345-392

Nieman DC et al (1997). *Int. J. Sports Nutr.*, 7, 173-184

## Oral Session

### Molecular Biology 1

O111C

#### O111C-1

### Polymorphism and exercise performance: A review of the genathlete study

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**Keywords:** genetics, polymorphism, endurance performance

In the last years a large cohort of more than 600 subjects has been recruited to establish a base for case-control designed investigations, comparing elite endurance athletes (EEA) and sedentary controls (SC). The goal of the study is to investigate polymorphism in selected candidate genes for endurance performance, potentially discriminating elite endurance athletes from sedentary subjects. The intention of

this particular talk is to present an overview of the results obtained till now.

The EEA group includes 306 Caucasian males recruited on the basis that they had a maximum oxygen uptake ( $VO_{2max}$ ) of more than 75 ml/kg/min-1. The SC group comprises 305 unrelated sedentary Caucasians with measured  $VO_{2max} < 50$  ml/kg/min-1. Both groups were matched by their country of origin. Several methods including Southern blotting, PCR technique, gel electrophoresis and automated sequencing were used to detect the polymorphism in the targeted genes. Till now, with about 70 polymorphisms tested in several candidate genes for endurance performance, there was evidence for association between EEA status and polymorphism in the genes encoding for the Alpha-2A-Adrenergic Receptor (ADRA2), the Nitric Oxide Synthase 3 (NOS3) and the Erythropoietin-Receptor (EPOR). No

association was found for the I/D polymorphism in the Angiotensin-Converting-Enzyme (ACE) gene, as well as in many other genes tested so far.

With the GENATHLETE study we established a valid and unique tool to test potential candidate genes for endurance performance phenotypes in a large cohort. Thus far, we found evidence for association with EEA status and polymorphism in the ADRA2, EPOR and NOS3 genes.

#### O111C-2

### The Forkhead transcription factor FoxO1 down-regulates transcription of p27Kip1 in response to IGF-I in primary skeletal muscle satellite cells

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**Keywords:** IGF-I, satellite cells, forkhead transcription factor FoxO1

Satellite cell activation contributes to the growth and repair of skeletal muscle in the postnatal stage. Insulin-like growth factor I (IGF-I) signaling pathway contributes to satellite cell proliferation. However, little is known regarding the mechanism by which IGF-I induces satellite cell proliferation. We have previously found that IGF-I-induced satellite cell proliferation is mediated via activation of phosphatidylinositol 3'-kinase (PI3K)/Akt pathway through down-regulation of a cell-cycle inhibitor p27kip1. We demonstrate here that Forkhead transcription factor FoxO1 contributes to mediating the effects of IGF-I on p27kip1 promoter activity.

The primary skeletal muscle satellite cells were isolated from the F1 generation of Fisher 344 × Brown Norway male rats (1-month old). When the satellite cells were transfected with a p27Kip1 promoter-reporter gene construct, reporter assays showed that IGF-I inhibited the p27Kip1 promoter activity. Addition of LY294002, an inhibitor of PI3K, reversed the IGF-I-mediated down-regulation of p27Kip1 promoter activity. Coexpression of wild type (WT) FoxO1 into satellite cells stimulated p27Kip1 promoter activity in the absence of IGF-I supplementation. Addition of IGF-I inhibited the WT FoxO1-induced p27Kip1 promoter activity.

However, when a mutated FoxO1, in which the three Akt phosphorylation sites in FoxO1 are mutated, was co-transfected, IGF-I was unable to inhibit p27Kip1 promoter activity that had been seen when WT FoxO1 was present. Western blot demonstrated that IGF-I stimulated phosphorylation of Akt-Ser473 and FoxO1-Ser256. In addition, the IGF-I-induced phosphorylation of Akt-Ser473 and FoxO1-Ser256 was inhibited with LY294002, implying that phosphorylation of Akt and FoxO1 was downstream of IGF-I-induced PI3K signaling. However, IGF-I was unable to induce phosphorylation of FoxO1 on other sites (Thr24 and Ser316).

These results suggest that IGF-I induced downregulation of p27Kip1 promoter activity via the phosphorylation of Ser256 inactivated FoxO1. Thus, IGF-I regulates adult skeletal muscle satellite cell proliferation through inactivation of FoxO1 transcriptional activity.

This research was supported by NIH grant AG-18780 (FWB) and fellowship AR-48514 (EES).

Chakravarthy MV et al (2000). *J Biol Chem* 275: 35942-35952

#### O111C-3

### Basement membrane type IV collagen and MMP-2 after forced lengthening contractions in rat skeletal muscle: effects of repeated bout

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**Keywords:** muscle fibre, type IV collagen, metalloproteinase-2

Muscular basement membrane type IV collagen turnover has been shown to increase after forced lengthening contractions in rat tibialis anterior (TA) muscle. The purpose of the present study was to investigate whether type of previous exercise prevents the changes caused by lengthening contractions. More specifically to investigate the effects of repeated bout of exercise on the expression of type IV collagen and matrix metalloproteinase-2 (MMP-2). Type IV collagen is located in basement membranes of muscle fibres, blood vessels and capillaries. It has been suggested that MMP-2 has an important role in degradation of type IV collagen.

The left TA muscles of 12 week-old male Wistar rats were subsequently unilaterally subjected to 240 forced shortening or lengthening contractions. Fused tetanic contractions were induced by electrical stimulation of the exposed common peroneal nerve via a stainless steel electrode. Shortening or lengthening of TA muscles were performed by either plantar or dorsiflexion of the foot at the ankle joint. Fifteen days later half of the both groups were subjected to second bout of exercise, forced lengthening contractions. The contralateral leg was used as an non-exercised control.

Light microscopical examination of transverse sections of TA muscle showed severe skeletal muscle fibre injury 4 days after forced lengthening contractions and both types of repeated bout of exercise (shortening + lengthening or lengthening + lengthening), but only slight histopathological changes after forced shortening contractions. Type IV collagen concentration elevated 4 days after forced lengthening contractions and both types of repeated bout of exercise, whereas after forced shortening contractions the increase was observed 15 days post-exercise. Gelatinolytic activity of proMMP-2 was increased 15 days after single bout of lengthening contractions, and 4 and 15 days after repeated bout of exercise. Active form of MMP-2 was observed 4 days after forced lengthening contractions and both types of repeated bout of exercise and 15 days after both types of single bout of exercises and repeated bout of exercise shortening + lengthening.

The results indicate that lengthening contractions increase type IV collagen concentration independently of previous treatment, whereas prior shortening and lengthening contractions may result to faster and more pronounced up regulation in type IV collagen degradation capacity after a repeated bout of contractions.

#### O111C-4

### The expression of MMP-2 and SOD in skeletal muscle: exercise vs immobilization

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**Keywords:** exercise, MMP-2, muscle

Matrix Metalloproteinase 2 (MMP-2), also known as Gelatinase A or 72kDa Type IV Collagenase, is a zinc-

dependent peptidase that functions extracellularly and mainly degrades fibrillar collagen type IV but also elastin, fibronectin, laminin and many other proteins located in the extra cellular matrix (ECM). It is constitutively expressed in myoblasts and fibroblasts within normal muscle tissue and is over-expressed due to various trigger factors such as inflammation, diseases and exercise. Many studies have demonstrated the role of antioxidant (AO) molecules such as superoxide dismutase (SOD) in aging and after training program. The aim of this study was to investigate the role of expression of MMP-2 and SOD activity in immobilized hindlimb muscles and after running program in muscles of young animals compared to old ones.

External fixation (EF) of the right knee joint in Wistar rats (7 and 24 months old) used as immobilization model, and for the running protocol. The duration of the immobilization was 1, 2, 3 and 4 weeks. The running protocol included slow speed (18m/min) and fast speed (25m/min), 3 times a week, gradually up to 60 minutes. Biochemical analysis included SDS-PAGE immunoblotting, and RT-PCR.

Old animals responded differently than the young ones both in EF and due to the fast running protocol. In general, our study demonstrated that MMP-2 is expressed after EF and following fast speed running and appear to be responsible to a large degree of ECM degradation. The expression of SOD was also higher in immobilized muscles as well as following a fast speed running. EF effected more negatively the young animals however, the fast speed running effected more negatively the aged rats.

Investigating the kinetic of protein degradation and synthesis in skeletal muscles of young and old rats following disuse and reuse is utmost important to understand a) how to minimize the disuse muscle atrophy, b) the Sarcopenia phenomenon and c) the capacity of muscle to regain its proteins after long period of disuse atrophy. Young animals are more influenced by EF but less effected by a fast running compared to the old animals.

#### O111C-5

### Association of five gene polymorphisms with physical performance in rowers

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**Keywords:** physical performance, rowing, genes polymorphisms

Association of genes polymorphisms with physical performance was well-known. The most valuable association was shown for I/D polymorphism of human angiotensin-converting enzyme (ACE) gene. Besides ACE gene I/D polymorphism, angiotensinogen gene (AGT), angiotensin II receptor 1 gene (AGT2R1), vitamin D receptor gene (VDR3), endothelial nitric oxide synthase gene (ecNOS) polymorphisms associations with physical performance have been shown. Renin-angiotensin system (RAS) plays the main homeostatic role in the human circulation. Because the investigation of the complex of main RAS genes polymorphisms will allow us only to do true conclusions about real genetic markers of physical performance in this system. ecNOS - a key enzyme of the endogenous nitrovasodilator system that is essential for the regulation of blood pressure. VDR3 participates in regulation of bone formation and resorption. As sport skills are caused by different genetic factors our aim was to study association of five genes polymorphisms with physical performance in rowers.

The polymorphisms of five genes ACE (I/D), AGT (M235T), AGT2R1 (A1166C), VDR (Taq), ecNOS (27 b.p. tandem repeat) were studied in rowers from Saint-Petersburg (N=56, men). These individuals provided a mouthwash sample and DNA was extracted from the buccal cells contained in this sample. Then the polymorphisms of five genes were determined by PCR-RFLP method. Genotype distribution and allele frequencies between groups of athletes and controls were compared by two tests.

Distribution of genotypes frequencies of AGT gene was different in both groups. Significantly higher frequency of T/M genotype was found in the group of rowers compared to control group (T/M - 68% and 31%, respectively;  $p < 0.01$ ). Distribution of genotypes 4/5 of ecNOS gene (38% and 31%, respectively), I/D of ACE gene (57% and 35%, respectively), A/A of AGT2R1 gene (57% and 39%, respectively), t/t of VDR gene (20% and 12%, respectively) was also different in both groups. Combined analysis did not reveal significant prevalence of genotype I/D (ACE), 4/5 (ecNOS), T/M (AGT), A/A (AGT2R1), t/t (VDR3) in rowers compared to control one. It might be speculated that T/M genotype of AGT gene has provided some inherited advantages for athletes' physical performance. Obviously this genotype should be reliable marker for sport rower selection.

#### O111C-6

### Natriuretic peptide fragments as new laboratory biochemical markers of rehabilitation of chronic heart failure patients

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**Keywords:** rehabilitation, hormones, heart failure

The most appropriate program of physical exercise rehabilitation for Chronic Heart Failure (CHF) patients is not fully known. The aim of this study was to evaluate natriuretic peptide fragments (NPfrs), namely proANP(1-98) (Atrial Natriuretic Peptide), a proposed prognostic marker of CHF, LANH, an ANP peptide fragment particularly involved in physical exercise, and NT-proBNP (Brain Natriuretic Peptide), a good marker of left ventricular dysfunction, before and after a training session.

To verify the effectiveness of a specific endurance training, NPfrs, in relation to echocardiography parameters, maximum oxygen consumption (fast ramp test) and structured questionnaires on life quality and symptoms of heart failure (MSHFQ, RESTQ) were measured/carried out on 20 CHF patients (NYHA I-II), randomly divided into two groups (A and B):

10 (group A) (68.4±1.9 years; 1.72±0.02 m; 82.3±6.1 kg), performed a specific rehabilitation program (8 sets of exercises for different muscle groups using training devices at 65% of repetition maximum, with 2 x 12 repetitions per muscle group, 3 times per week for 12 weeks);

10 (group B) age matched, performed the phase III cardiac rehabilitation program.

Plasma samples from blood EDTA, collected after overnight fasting, were stored at -80° C until assay.

NPfrs assays used competitive EIA methods and biotinylated analogues, peroxidase streptavidin reaction and detection at 450 nm were employed. Statistics: Friedman ANOVA (significance:  $p < 0.05$ ).

Both proANP (1-98), LANH and NT-proBNP values were not significantly different before and after rehabilitation programs either in group A or B. proANP(1-98) showed a significant correlation with NT-proBNP just before training session



( $r=0.72$ ,  $p<0.02$ ) in group A and at the end in group B ( $r=0.7$ ,  $p<0.03$ ). During the training there were no cardiovascular problems. The ejection fraction and the left ventricular diameter remained unchanged in both groups (training and control groups) after 12 weeks. Referring to the questionnaire (MLHFQ) there was an improvement in

general well being, in all-day activities and in fatigue in the training group and no improvement in the control group.

The present results suggest that the NPfrs assays confirm the maintenance of left ventricular and follow-up CHF during a training session.

## Symposium

### History of Sport Science

**S111D**

#### S111D-1

#### Born out of conflicts: the origins of sport science in Europe

**Renson Roland**

K. U. Leuven, Belgium

*Keywords: history, conflicts in sport science, paradigms of sport science*

In the late 19th and early 20th century Europe conflicts happened in Germany, France, Belgium and Denmark between rivaling gymnastics factions, each 'fencing' with scientific or pseudoscientific arguments. In 1860-62 in Germany a scientific duel was fought between Hugo Rothstein and Du Bois-Reymond, concerning the scientific superiority of Swedish versus German gymnastics. Rothstein, who had banned the horizontal and parallel bars from the Royal Central Military Institute for Gymnastics in Berlin, was refuted by the Royal Scientific Committee for Medical Affairs in 1862. In France Demenij clashed with Tissie, over the scientific nature of Swedish gymnastics. Tissie succeeded in introducing the Swedish system in the Military Normal School of Gymnastics of Joinville-le-Pont in 1904. Lefebure won the system struggle in Belgium against Happel, using anthropological statistics to prove the superiority of the Swedish system. This led to the introduction of Swedish gymnastics in the Belgian army in 1904.

Physiologist Lindhard was appointed in 1909 at the University of Copenhagen to teach gymnastics theory. He was confronted with conservative gymnastics inspector Knud Knudsen, who resigned in 1927. The outcomes of these conflicts were often more determined by the political power of their advocates than by their research data. These conflicts led to a paradigmatic shift from posture to motor behaviour and originated sport science in Europe.

#### S111D-2

#### The origins of sport science in South America: The case of Brazil

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State University of Campinas and CNPq/State University of Center-Wes, Brazil

*Keywords: history*

The origins of sport science in Brazil were studied through literature and interviews with different actors. The establishment of the institutionalisation of sport science in the country had its roots in the second half of the 19th century. It was influenced by the way physical education and sport were organised in Europe and also by the governmental needs to modernise the country. The hygienic, moral, military, nationalist, eugenic and masculinity arguments were the base for the physical education and sport development. The

practice was imposed by the military and medical circles in the school systems since the 19th century, and in the organisation of sport clubs and of sport scientific associations in the 20th century. The research studies were institutionalised in the seventies with the organisation of three Governmental Laboratories in the Faculties of Physical Education in the (i) State University of São Paulo, (ii) Federal Universities of Rio de Janeiro and (iii) Rio Grande do Sul and, with the non-governmental Laboratory of São Caetano do Sul - CELAFISCS. The most recent laboratories have been organised with the creation of graduate programs in the universities. The research topics until the eighties were in exercise physiology and anthropometry with the goals of talent detection and the impact of physical activity on growth and development. The studies on sport psychology, sociology and history started in the last twenty years. The firsts scientific organisations were created early in the seventies: the Brazilian Federation of Sport Medicine and the Brazilian College of Sport Science - BCSS which had broader goal to include different sport professionals. Other Scientific Organisations were founded later in specific areas of interest. The most recent tendency in the country is the organisation of thematic or inter-disciplinary groups from different universities.

#### S111D-3

#### Sport science in 19th and 20th century America: a history

**Barney Robert**

University of Western Ontario, Canada

*Keywords: physical education*

A rapidly developing 19th century American urban-industrial character spawned a plethora of concerns related to the health and well-being of American citizens. Well intentioned health reformers, lay practitioners, and entrepreneurial-bent faddists railed against such negative by-products of urban industrial living as pollution, unsafe working conditions, and living atmospheres injurious to personal health and body fitness. From the numerous crusades mounted to "improve conditions," together with concerns registered by college and university officials for the health and fitness of students, sprang the beginning of the study of sport science, a discipline largely pursued in American institutions of higher learning by medical doctors, knowledgeable in anatomy and physiology, the very foundation for understanding the human body and its function. Initiated at Amherst College in 1860 by Dr. Edward Hitchcock, followed shortly after by Dr. Dudley Sargeant of Harvard College, the discipline of sport science grew in time to include study of the humanities--sport and physical education history, philosophy, sociology, and organization. This paper will explore in synthesis form the shaping of sport science in America, the discipline's foremost pioneers and leaders, and the inherent issues that the discipline faced as it

evolved in a world where more and more folks became concerned about what personal health and fitness could mean in the lives of humankind.

#### S111D-4

### Statistics and gymnastics: The origins of movement science in Belgium (1869-1908)

**Delheye Pascal**

University of Leuven KULeuven, Belgium

*Keywords: history, gymnastics*

The Higher Institute of Physical Education at the University of Ghent (1908), incorporated within the Faculty of Medicine, was the first university institute in Europe to create 'candidate', 'licentiate' and doctoral degrees in physical education. It was the outcome of a long struggle between two rival groups, each claiming the scientific superiority of their gymnastics system. The introduction of statistics in the field of gymnastics, its role in the systems' struggle, and its effect on the institutionalisation of a new academic discipline, is analysed in this paper. Special attention is paid to the influence of the Belgian scientist, Adolphe Quetelet, on two major opponents in the systems' struggle: Jacob Happel

(propagating his adapted system of German Turnen) and Clément Lefébure (propagator of Swedish gymnastics). The publications of Happel and Lefébure were screened on the use of anthropometrical and physiological data and their statistical analysis.

Quetelet inspired both Happel and Lefébure. Happel attempted to introduce scientific concepts and statistical methods in 1869, but would argue in 1903 that detailed anthropometrical research was useless in the field of gymnastics. On the contrary, the actions of his 'Swedist' opponent, Lefébure, led to the implementation of statistics in the field of gymnastics in Belgium. The latter started in 1902 a comparative experiment to investigate the effect of Swedish gymnastics and German Turnen on anthropometrical and physiological parameters. The statistical data (from pre- and post-test measurements), combined with photographs of the remarkable results, had to prove the superiority of the Swedish method. Lefébure won the struggle.

Physical education was indeed officially acclaimed and institutionalised in 1908, at the University of Ghent, because of the so-called "regenerative" effects of Swedish gymnastics. Over all, it seems that statistics were used to provide a scientific 'aureole'. Nevertheless, these pioneering efforts to introduce quantitative research methods in the field of gymnastics laid the foundation of sport science in Belgium.

## Oral Session

### Computer Science in Sport

#### O111E

#### O111E-1

### SpInSy - an e-Learning system for the scientific theory of selected sport disciplines

**Eder Christian, Baca Arnold, Kornfeind Philipp, Strubreither Oliver**

ISW, University of Vienna, Austria

*Keywords: e-learning, multimedia, internet*

SpInSy - Sport Scientific Information System - is developed to transmit scientific basics of four selected sport disciplines (Alpine skiing, Tennis, Track and Field Athletics - in particular running and jumping disciplines - Soccer) using internet and multimedia technology. The aim of the project is to arouse the interest in studying theoretical sport scientific concepts more intensively and to obtain a more rapid understanding for complex connections. We expect to improve the interdisciplinary understanding in sport science both in research and education and to achieve a more economic and effective education.

Four modules are developed according to the four disciplines. The online availability of the modules shall enable users to earn, refresh or deepen their knowledge, independent of time and place. Computer animations, video sequences (e.g. to control the ability to diagnose anomalies in motion performance or to specify the cognitive representation of movements) and simulations are included into the modules in order to achieve a high degree of interactivity. An explorative learning concept is utilized. The learners shall take an active role in discovering and absorbing knowledge on their own. They may choose their own passage, they are able to interact within the environment and to explore certain problems - so the users themselves are responsible for the success of the learning process. A cross-platform approach was a major criterion for selecting the development environment (Macromedia

Authorware 6.5). The system developed should run on both Windows PCs and Macintosh computers.

Prototypes of all modules have been developed and have been evaluated by students of sport science. Students were unfamiliar with the explorative learning concept. More navigational help in order not to get lost in the complexity of the structure was required. Concerning the technical criteria evaluation results were satisfying and complied with the expectations. The system has not yet been compared to traditional teaching methods at the present stage of the project.

Based on these results the learning environment will further be improved. The explorative learning concept will still be followed. We believe that there is no harm in getting a little lost - it fosters explorative behaviour. SpInSy shall be completed and made accessible to educational institutions in Austria in autumn 2003.

*Haggerty TR (2000). Computer science in Sport: 13-33*

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*Weigelt S, Starischka S (2000). Computer Science in Sport: 34-40*

## O111E-2

**Application of an internet based, collaborative software environment in training and competition of top level beach volleyball teams****Link Daniel, Lames Martin**

University of Augsburg, Germany

*Keywords: groupware, internet training, beach-volleyball*

During the last years, many methods for the genuine informational coupling of training and competition were suggested and applied to improve performance in sports. In the majority of cases, the systematic analysis of the own and the opponent's technical and/or tactical skills, and conclusions on the training process, requires the physical presence of coaches at the competition location. In semi-professional sports, this "on the spot" service causes serious financial, logistical, and organisational problems due to restricted resources of players and federations. By using modern information and communication technology, these problems can be alleviated.

The generic term groupware describes software systems, which support groups of geographically distributed people engaged with a common task, and provide an interface to a shared environment.

To enable the German top level beach volleyball teams to work collaboratively with their coaches via the internet, the University of Augsburg developed a groupware system, labelled VIAS v.4 (Video-Analysis-System), which provides the following features: video analysis of beach volleyball games based on a qualitative observation method; real-time video and audio conferencing; text messages for internet connections with poor bandwidth or high latency; application viewing/ sharing by broadcasting analysis results, videos and mouse movements between two software instances; specialized white-boards and tactic charts to demonstrate player positions and their dynamic interaction.

These key functions allow supplying players with relevant information all around the world. Taking advantage of a central reporting station, many teams could easily be equipped with scientific services without generating travelling expenses. The practical implementation of the developed software system will start in cooperation with the German beach volleyball teams, during their Olympic qualification in summer 2003.

## O111E-3

**Software for planning sport training: application for basketball****Pérez Miguel Ángel, Macías Mercedes, Ibáñez Sergio José, Feu Sebastián**

University of Extremadura, Spain

*Keywords: basketball, control of training*

Traditionally, the preparation of the coaching plan for team sports was a manual, autodidactic and subjective process. In this process, coaches registered some of the training elements that defined an exercise. The correctness of the training process planning is a laborious work. It is distanced from the classical conception of training-art in which the coach manipulates intuitively some variables of this process. It has to establish and exactly define the higher number of variables that affect the developing coaching process. And it has to be done at the beginning of the season. This generic definition will be used as a guide to consolidate and develop the different stages of the training. Also, the planning process

must be a dynamic process. In this sense, the coach has to compare what was planned with what is performed. Then, the coach has to fit the changes to the original design, in order to adapt to real training necessities.

## O111E-4

**Computerized electric-puncture diagnosing in the system of comprehensive examination and assessment of elite athletes****Sukhov Sergey, Kulnazarov Anatoliy, Ivanov Alexander**

National Research and Practical Center of Physical Culture, Kazakhstan

*Keywords: elite sport, computer science*

It is known that Biologically Active Points (BAP) is an objective indicator of the state of athletes. Application of computer technology allows increasing the quality of measurements and analysis of findings.

Electric-puncture diagnostic scheme (EDS) has been utilized for measuring the BAP electric-physiological characteristics. Measurements were taken from 40 control (c) BAPs of the all arm and leg meridians on the both sides of the body. Also a number of calculated indicators was determined, including the sum of cBAPs of heart and lung meridians, and an 'upper: lower' ratio. Measurements were taken at rest and after a physical load. Routine tests accompanied the examination. Twenty elite athletes engaged in ski racing and pentathlon have been examined. The control group included 28 athletes (aged 17-21 years) of a lower athletic qualification.

The elite athletes had higher readings of the all measured electric-puncture indicators, compared to the control group, both prior to and after the physical load. Cardio-vascular and respiratory systems play a key role in adapting to protracted physical loads. The elite athletes had a significantly higher sum of cBAPs of heart and lung meridians, in comparison with lower qualification athletes ( $238.4 \pm 9.0$  c.u., and  $167.1 \pm 7.7$  c.u. at rest,  $P < 0.05$ ; and  $286.2 \pm 8.0$  c.u., and  $198.5 \pm 9.6$  c.u.,  $P < 0.05$ , respectively). Correlation analysis has been accomplished. There were revealed close correlations between the sum of cBAPs of heart and lung meridians, and all the other measured electric-puncture indicators ( $r = 0.89-0.97$ ) in the both groups. This proves that the sum of cBAP of heart and lung meridians is an universal indicator, and at express diagnosing one could be confined to measuring of these four BAPs only. The elite athletes had correlations between the sum of cBAPs of heart and lung meridians, and PWC170 ( $r = 0.72$ ) and maximum oxygen consumption ( $r = 0.65$ ). The control group did not display such correlations. The elite athletes had a considerably higher 'upper- lower'; ratio as opposed to the control group ( $0.96 \pm 0.01$  and  $0.75 \pm 0.02$ ,  $P < 0.01$ , respectively) that tells about their significantly better state of balance.

The sum of electric-physiological indicators of cBAPs of heart and lung meridians was the most informative indicator. This indicator allows easily assessing the functional state of athletes exercising endurance training.

O111E-5

**Performance diagnosis by computer simulation in table tennis****Zhang Hui, Hohmann Andreas**

University of Potsdam, China

*Keywords: table tennis, game analysis, computer simulation*

In table tennis, the series of the interactive game actions (e.g. serve, return, offense, defense, and so on) can be registered chronologically so that the frequencies of each transition between the different states of the game flow can then be described by means of a statistical transition matrix. In a second step, the series of the game actions is modeled by a Markov chain. This statistical model of the game makes it possible that the relevance of each game action for the final win or loss of the game can be simulated.

In the study, 152 matches of the top 50 male world class players were assessed. For the match analysis the sample was divided into four groups: shakehand vs. shakehand player, shakehand vs. penholder player, penholder vs. shakehand player, and penholder vs. penholder player. The game observations included the categories (1) game action, (2) stroke position, (3) stroke direction, and (4) stroke technique.

When the transition rates from the neutral game actions of one player to the defense action of the opponent were raised only by a small amount, then the probability of winning the game was highly increased compared to the other game actions ( $F=121,33$ ;  $p<0.001$ ). Among the different stroke directions, a strike from the long backhand side to the long backhand side of the opponent was most successful ( $F=89,56$ ;  $p<0.001$ ). Especially in shakehand players, the topspin showed the highest relevance of all techniques for the win of the match ( $F=8,07$ ;  $p<0.001$ ).

The results show that the performance diagnosis on the basis of the mathematical simulation of success probability by means of the Markov-chain model is a worthwhile procedure in table tennis.

O111E-6

**A novel 3D local position measurement (LPM) technology****Leitner Rainer, Fischer Alexander, Söser Andreas, Baca Arnold, Smekal Gerhard, Hofmann Peter**

Karl-Franzens University of Graz, Austria

*Keywords: tracking, local position measurement, realtime position analysis*

Local Position Measurement Technology (LPM) used for control & monitoring of industrial equipment & processes. The steadily growing demand for object tracking, coming from the industry, was the main motivation for this development. The area of application reaches from wide range object tracking for logistic purposes in an outdoor environment to motion capturing, indoors, of a single employee to optimise his working environment. The realtime capability and the high accuracy of the system requires proficiency in terms of sensing, signal processing, communication as well as data processing.

The determination of position is based on the measurement of the time of flight of high frequency pulses between a tag (transmitter) and a measuring unit (receiver). To achieve an accuracy of 10 cm the signal processing has to be done with time resolution below 300 ps. The position can be calculated with the values of at least four different measuring units. Therefore the data has to be transmitted to a master processing unit. The processing unit is responsible for activation of tags, for collecting and storing of measurement data and calculation of the position. To increase the availability of sensible position data, the measurement values of more than four measuring units are used, resulting in an overdetermined system of nonlinear equations which are solved numerically. Within the master processing unit the position of each tag which is in the system is known. To ensure accessibility of tags during movement through the measurement area, the system predicts the measuring unit from which the activation of a tag for a measurement can be done with highest probability.

With FMCW based sensors, a wide range realtime network and a processing unit with realtime capability it is possible to measure three dimensional position of a tag within an area of several acres with accuracy below 10 cm 1000 times per second.

**Symposium****Psycho-Social Aspects of Elite Sport****S111F**

S111F-1

**A developmental perspective on the psychosocial influences throughout the elite athlete's sport career****Wylleman Paul**

Vrije University of Brussel, Belgium

*Keywords: sport career, elite sport, psychosociology*

Research has shown that elite athletes' sport careers develop in four normative stages – the initiation, the development, the mastery, and the discontinuation stage – and that athletes need to cope successfully with the transitions that occur in-between two stages in order to be able to progress (Lavalée & Wylleman, 2000; Wylleman, Alfermann, & Lavalée, in press).

Empirical data gathered with former Olympic athletes, elite student-athletes and talented young athletes competing in a wide variety of sports have tentatively provided average ages for the occurrence of each transition and for the developmental tasks they face or have faced throughout their athletic career. The transition into the initiation stage, where young athletes are introduced to organized sports and during which they are identified as talented athletes, occurs at approximately 6 to 7 years of age; at age 12 to 14 young athletes make the transition into the development stage during which they become more dedicated to their sport and where the amount of training and level of specialization is increased; the transition into the mastery or perfection stage, in which athletes reach their highest level of athletic proficiency, occurs generally roundabout 18-19 years of age; and the final transition which elite athletes make, that is the termination of their athletic career and the start of the

discontinuation stage has been situated between 28 to 30 years of age – a post athletic career stage which could last for several years.

Recently, in view of the concurrent, interactive and reciprocal nature of athletes' development at athletic and non-athletic level, the need for a more holistic and life-span approach to the study of the athletic and post-athletic career of elite athletes has been advocated. In line with this recommendation, a developmental model was proposed which provides a normative view on the development of athletes at athletic, psychological, psychosocial, academic and vocational level (Wylleman & Lavallee, in press).

One of the important aspects in athletes' development is the role, influence and quality of their interpersonal relationships (Wylleman, 2000). As an introduction to the invited symposium "Psycho-social aspects of elite sport", this presentation will (a) provide a rationale for the need of a holistic and life-span approach to the study of elite athletes' sport career, and (b) illustrate the importance to athletes' development of the possible interaction and reciprocity between the developmental stages at athletic and non-athletic level.

On the basis of this developmental model, three experts will present data on the psychosocial development of elite athletes, and more particularly, on the role and influence of parents, coaches and peers throughout the elite athlete's sport career.

Wylleman P (2000). *Int J Sport Psy* 31: 555-572

Wylleman P, Alfermann D, Lavallee D (acc publ). *Psy Sport Exercise*

Wylleman P, De Knop P, Ewing M, Cumming S (2000). In Lavallee D, Wylleman P, *Career transitions in sport: International perspectives*: 143-160

Wylleman P, Lavallee D (in press). In Weiss M, *Developmental Sport and Exercise Psychology*

### S111F-2

## The role and influence of the coach in the development of the elite athlete's sport career

**Harwood Chris**

Loughborough University, United Kingdom

**Keywords:** coach, elite sport, transitions

Although the literature on effective coaching and optimal coaching behaviours has burgeoned over the past 20 years (e.g., Smith & Smoll, 1996), the precise roles and influence of the coach from a developmental and transitional perspective in elite sport is less well documented. The purpose of this presentation is to consider the role of coach as a pivotal agent not only in the athletic, psychological and social transitions that athletes experience, but also in the academic and financial transitions that athletes have to come to terms with as they approach senior and professional levels.

Drawing upon the tenets of achievement goal theory (Nicholls, 1984) and self-determination theory (Deci & Ryan, 1985), the psychosocial role of the coach will be examined during the three specific transitions delineated by Bloom (1985): the initiation stage (into sport); the development stage; and the mastery stage. Real life cases of athletes will be presented in order to illustrate the importance of the coach developing a task involving motivational style in order to optimise a particular transition. Further, the coach's role in assessing the quality of the motivational climate (Ames, 1992; Newton, Duda & Yin, 2000) created by parents,

siblings and peers, and intervening where possible, is critical during the pre-teen years and throughout adolescence.

Implications for a coach's (lack of) awareness of the different developmental transitions beyond simple chronology (i.e. psychological, social, athletic, physical/technical, academic and financial transitions) will also be examined, particularly with respect to athletes who are 'passed on' to new coaches following an organisational transition. A coach's appreciation of the athletic and academic identity of the athlete will be discussed here, as well as the quality of coach-parent-teacher relationships and communication.

Finally, the concept of 'transitional synergy' will be explored using a real case example of the role of the coach in professional team sports. Specifically, the presentation closes with a glance at the potentially negative impact of athletic, organisational and financial transitions that are externally forced upon the athlete before their readiness in psychological or educational terms. In sum, the importance of coach education of transitional issues to facilitate effective coaching behaviour is highlighted as a requirement for youth sport organisations.

### S111F-3

## The role and influence of parents in the development of the elite athlete's sport career

**Weiss Maureen R**

University of Virginia, United States

**Keywords:** elite athletes, sport career, parents

Parents are important sources of positive and negative influence at various ages (childhood, adolescence) and levels of athletes' sport careers (initiation, development, mastery). To date, the majority of studies have explored parental influence among young recreational and competitive participants either as they transition into sport (initiation stage) or transition out of sport (discontinuation stage). Relatively fewer studies have explored parent-child relationships among high-level competitors at the development and mastery stages of their career. Studies that reveal the crucial role of parents in elite athletes' careers have mostly focused upon Olympic individual sports such as gymnastics, figure skating, tennis, and swimming (see Weiss, Amorose, & Allen, 2000). Some robust findings emerge across these studies. First, greater support by and more positive relationships with parents are associated with higher enjoyment, self-perceptions, and motivation, and less anxiety and stress. Second, greater pressure by parents and feelings of obligation to remain involved to please parents are associated with feeling entrapped in sport. Third, more criticism by and negative interactions with parents are sources of burnout among elite athletes. Fourth, recollections of negative parent-child experiences include broader issues such as missing out on a family life, sibling jealousy, and social implications of delayed puberty. Thus, some data exist of elite athletes' social relationships and their impact on their development as an athlete at various stages of their career, but little is known from a systematic, developmental perspective. Wylleman and Lavallee's (in press) developmental model on transitions faced by athletes offers promise for future studies of elite athletes' psychosocial experiences across the lifespan of their sport careers.

Weiss MR, Amorose AJ, Allen JB (2000). In Drinkwater BD (Ed), *Women in sport: Volume VIII, Encyclopaedia of sports medicine*.

Wylleman P, Lavallee D (in press). In Weiss MR (Ed), *Developmental sport and exercise psychology: A lifespan perspective*.

## S111F-4

**The role and influence of peers in the development of the elite athlete's sport career****Smith Alan**

Purdue University, United States

*Keywords: elite athletes, peers, talent development*

For young athletes who show considerable early talent, coaches and parents play a significant role in fostering an environment that enables the athlete to acquire expert performance (Côté, 1999; Gould, Dieffenbach, & Moffett, 2002). Surprisingly, sport researchers have not extensively explored the role and influence of peers in the development of expert performance. Arguably a young athlete's peers could contribute to or detract from this process. The purpose of this presentation is to provide justification for such a research line as well as discuss conceptual and methodological issues of relevance to the study of peers and talent development in sport. Recent studies suggest peers may be important in an elite athlete's development. Durand-Bush and Salmela (2002) found that opportunity to learn from other athletes, friends outside of sport, team cohesiveness, and jealousy/competitiveness among athletes were salient during the investment and maintenance years of the careers of athletes holding multiple Olympic and/or World titles. Patrick et al. (1999), in a study of non-elite adolescents

identified as possessing talent in sport or the arts, found that peer relationships were salient to continuing involvement in and commitment to their area of talent. Combined, these findings suggest peers both within and outside the sport context may impact the development of expert performance. The pursuit of research on the role and influence of peers in the development of expert performance will require attention to a number of conceptual and methodological issues. Peers can be examined within relationship frameworks that emphasize particular friendships or acceptance by the larger peer group (Smith, 2003). Peers can also be examined relative to their degree of balance in competencies, reciprocity and stability of connection, or degree to which they are embedded within and influenced by particular social networks. Thus, multiple levels of analysis and use of a variety of methodological techniques will be required to best advance the knowledge base. Additionally, such work should be developmental in nature and couched within existing conceptual frameworks of talent development.

*Côté J (1999). Sport Psychologist 13: 395-417**Durand-Bush N, Salmela JH (2002). J Appl Sport Psy 14: 154-171**Gould D, Dieffenbach K, Moffett A (2002). J Appl Sport Psy 14: 172-204**Patrick H, et al. (1999). J Youth Adol 28: 741-763**Smith AL (2003) Psy Sport Exercise 4: 25-39***Symposium****Biomechanics in Elite Sport Performance****S111G**

## S111G-1

**Biomechanics in elite sports: Performance enhancement and injury prevention****Brüggemann Gert-Peter, Arampatzis Adamantios**

German Sport University Cologne, Germany

*Keywords: biomechanics, injury prevention, elite sport*

Both objectives performance enhancement and injury prevention apparently seem to be juxtaposed. Performance enhancement e.g. in a jump implies the maximisation and the use of the mechanical energy of the athlete generated during run-up and take-off. Load optimisation, on the other hand, deals with the reduction and decrease of energy. If one understands performance and load optimisation as performance maximisation and load minimisation this contradiction becomes apparent and cannot be solved. However, if one defines optimisation in relation to performance as well as in relation to load this contradiction is only of an apparent nature. This step to performance and load optimisation signifies the essential task of the application of biomechanics to elite sports; performance optimisation alongside with justifiable loads is one of the intrinsic and most important fields of biomechanics applied to elite sports.

From such a standpoint biomechanics plays an important role to increase the mechanical outcome of the musculo-skeletal system under the given physiological potential and energy resources. The optimal use of the individual biological resources seems to be the key to improve elite sport performance.

Injuries cause interruptions of training and/or decreased the intensity of practice. Decreased training intensity and volume will possibly lead to poor preparation for an optimal use of

the physiological resources and to a poor preparation of the physiological preconditions in terms of muscle strength and/or aerobic capacity but also bone and soft tissue integrity. In general mechanical loading of the musculoskeletal system is a prerequisite for morphological and functional adaptation of biological material. But if stress and strain increase to a certain level and exceed the mechanical limits of the individual structure, mechanical loading may lead to tissue damage. From this point of view injury prevention should play a significant role in the use of biomechanics in elite sports.

The purpose of this paper is focussed on both, the performance optimization and the study of mechanical loading of structures which should be of risk in the specific sport. The first objective is the explanation of the impact of the individual capacity or potential of the muscle-tendon-unit and its utilization by the athlete in order to produce the mechanical outcome of a given sport performance or technique. From this standpoint biomechanically based injury prevention through the estimation and control of mechanical loading of the musculo-skeletal system.

Examples from track and field, gymnastics and luge start techniques will be used to explain that (a) individual solutions for a given task exist and (b) these solutions are strongly related to the capacity and potential of the muscle-tendon-unit and the given morphology of the musculo-skeletal system.

The application of biomechanics to training and performance in elite sports cannot be reduced on the application on mechanical laws and principles of motion. The individual potential in force production and/or energy storage and reutilisation capacity plays the major role to explain the individual performance.

## S111G-2

**Application of biomechanics technology to athletic performance**

Viitasalo Jukka

KIHU-Research Institute for Olympic Sports, Finland

*Keywords: on-line feedback*

The role of biomechanics in sports performance can be seen e.g. in technique, stress reduction and equipment design. I will concentrate on technical aspects in my presentation. Biomechanics in connection with the modern audio-visual and computer technology has offered new possibilities to analyse and visualize fast movements and such "invisible" variables as e.g. force, acceleration and muscular activity while improving athletic performance. Computer based technology offers possibilities to give feedback immediately after the performance, even during the performance in order to guide and facilitate the learning process.

In the sports biomechanics video shooting and motion analysis have been largely used to analyse athletic performance. New methods and programs to edit video material and to utilize digital video databases have offered improved possibilities to utilize video data while teaching motor skills. An interesting and challenging way to utilize biomechanics technology for sport is to develop on-line feedback methods.

In the KIHU- Research Institute for Olympic Sports we have used infrared photocell measurements to detect run-up speeds e.g. in track and field. In order to measure release speed and release angles for flying objects like javelin, a computerized photocell gate, consisting of two infrared walls was built. Infrared technology was also used to construct "a photocell contact mat" for measurements of ground contact time and flight time parameters in running. Radar measurements we have used to detect instantaneous speed in several sport events. Force platforms have been applied to study ground reaction forces in running and jumping, and swaying in shooting. Force transducers have been constructed to detect paddle forces in kayaking, trigger and butt forces in shooting, and ski pole forces in x-c skiing. A special lab was established to study biomechanical characteristics of pistol, rifle and running target shooting. Wind tunnel tests have been used to study flying positions and suits in ski jumping.

During the past few years a special emphasis has been put in the KIHU Institute on developing a multimedia feedback system. This allows viewing on the same screen and in the same time phase, synchronized video pictures and several signals measured from an athlete (EMG, heart rate), from a sports implement (gun forces in shooting, paddle forces in kayaking) or from the surrounding (ground reaction forces).

## S111G-3

**Biomechanics on performance enhancement in ski-jumping**

Schwameder Hermann, Müller Erich

University of Salzburg, Austria

*Keywords: sport performance, ski-jumping, biomechanical tests*

The main purpose of biomechanical investigations of ski-jumping is to enhance performance. Aspects of safety and injury prevention are rare. Biomechanical studies deal with aspects concerning technique in hill jumps and simulated take-offs, the optimisation of hill profiles and improvements of the material. This paper presents some studies on

biomechanical methods used to enhance performance in ski-jumping.

The take-off is attributed the highest significance in ski-jumping, as optimal initial conditions for the subsequent flight can be created only in this phase. Positive correlations between vertical release velocity and jumping distance were found to be between  $r=0.30$  and  $r=0.61$ . Additionally, positive correlations with jumping distance were observed also for ballistic parameters, as 'production of a great angular momentum' and 'high leg-extension velocity'. The early flight phase is another sensitive phase in hill jumps. Two studies ascertained performance-related variables using multivariate approaches. According to these the jumping distance correlated highest ( $R=0.89$ ) with a combination of high vertical release velocity, high knee-angle velocity, great torque during the take-off and a small body/ski angle after 20 m of flight. Studies using force platforms integrated into the take-off table compared the maximal ground reaction forces between different jumpers. The increasing force development towards the end of the take-off phase may well characterize the main advantage of the elite jumpers. Another study used pressure insoles in order to measure the pressure distribution under the foot. The data showed that each jumper had a very specific force distribution profile with significant differences between the jumpers.

Simulated take-offs are often used in ski-jumping dryland training. Several studies investigated comparatively the kinematic and kinetic structure as well as the muscle-specific coordination between hill jumps and simulated take-offs. It has been shown that the explosive power is one of the best predictors of high-class simulated take-offs. The duration of hill-jump take-offs is about 30% and significantly shorter than in simulated take-offs. Several reasons can be asserted for this fact (e.g. plantar flexion with training boots, aerodynamic forces).

Some general conclusions can be drawn from these studies, however, in future more subject-specific information has to be considered to assess the intra-individual factors limiting performance in ski-jumping.

## S111G-4

**Biomechanics in cross country skiing performance**

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*Keywords: skiing, skating, mechanics*

Optimization of technique to improve sport performance is a complex process to which sport biomechanists can contribute data and understanding. In an endurance sport like cross-country skiing, physiology is of course very important but biomechanical factors play a substantially larger role in affecting performance than may be the case in running, for example. A fundamental observation about skiing involves the interaction of cycle frequency and cycle length in determining skiing speed. Faster skiers are consistently found to ski with greater cycle length than slower skiers while frequencies are similar. Understanding how technique and equipment contribute to this relationship is a major objective for biomechanists involved in ski research. In its simplest form, ski performance can be explained as an equilibrium between the forces involved: ski and pole reaction forces, snow and air drag forces, and gravity. The fastest skiers are able to reach equilibrium at greater speeds perhaps due to generating greater reaction forces but also by minimizing drag forces acting against forward motion.

Kinematic characteristics of skiers have been measured in both race conditions on snow and in laboratory conditions using roller skis and a treadmill. From video or other motion analysis systems, skier positioning has been determined and various characteristics such as ski speed and angular position calculated. Kinetic characteristics in skiing have been only rarely measured. Instrumented skis and poles interfaced to data logging hardware allow direct measurement of the forces acting to propel a skier.

Explaining the enhanced cycle length for the fastest skiers has involved focus on equipment and on technique. Considerably faster ski glide speed partially explains how the

fastest skiers obtain greater cycle length but technique factors are also involved. In the skating stroke if ski speed slows considerably, cycle length will likely be shortened. Skiers with better technique tend to maintain ski speed more constantly during the skating stroke than do those with technical deficiencies. Ski speed is affected by positioning factors of the pelvis and shoulders, center of mass with respect to the foot, and direction of the ski reaction force. Individualized assessment has been used with some elite skiers for subtle adjustment of technique characteristics which have resulted in improved performances.

## Symposium

### Elite Sport and Immune System

S111H

#### S111H-1

#### Potential nutritional countermeasures to exercise-induced immunosuppression

Nieman David

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*Keywords: exercise, nutrition, immunology*

In contrast to moderate physical activity, prolonged and intensive exertion causes numerous changes in immunity that reflects physiologic stress and suppression, and an increased risk of upper respiratory tract infection. In that multiple enzymes in immune cells require the presence of micronutrients, attempts have been made to alter changes in immunity following heavy exertion through use of nutritional supplements, primarily zinc, dietary fat, vitamin C and other antioxidants, glutamine, and carbohydrate. Except for carbohydrate supplementation, none of these nutrients has emerged as an effective countermeasure to exercise-induced immunosuppression. Data from several studies of endurance athletes suggest that carbohydrate compared to placebo ingestion is associated with an attenuated cortisol, growth hormone, and epinephrine response to heavy exertion, fewer perturbations in blood immune cell counts, lower granulocyte and monocyte phagocytosis and oxidative burst activity, and a diminished pro- and anti-inflammatory cytokine response. Overall, the hormonal and immune responses to carbohydrate compared to placebo ingestion suggest that physiologic stress is diminished, although clinical significance awaits further research.

#### S111H-2

#### Muscle-derived interleukin-6 - a sensor of energy crisis in the muscle?

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*Keywords: muscle, cytokines, IL-6*

Cytokines are signalling peptides, which were originally discovered within the immune system. Recent studies, however, demonstrate that cytokines also play multiple roles in regulating metabolism and muscle adaptation. Recently, we have shown that contracting skeletal muscles, independently of muscle damage, produce and release the cytokine interleukin-6 (IL-6) and that IL-6 is produced by muscle fibers of all types. In addition, we have demonstrated that the transcription rate and release of muscle-derived IL-6 is further enhanced when muscle glycogen content is low.

The biological roles of IL-6 are many: 1) Activation/inhibition of metabolic genes; 2) Induction of lipolysis 3) Induction of anti-inflammation 4) Enhancement of insulin sensitivity and 5) Induced cortisol production. Carbohydrate supplementation during exercise and anti-oxidant supplementation prior to exercise inhibit the release of IL-6 from contracting muscle. Dietary modification of the cytokine response to exercise may have implications for both training adaptation, but may also inhibit the beneficial effects of exercise such as protection against.

*Keller C, et al. FASEB Journal, 15 (14): 2748-50, 2001*

*Starkie R, et al. FASEB J – in press – published online March 5, 2003*

*Hall Gv, et al. J Clin Endocrin Metab – in press 2003*

#### S111H-3

#### Exercise-induced immune changes in athletes: Influence of recovery period

Ronsen Ola, Klarlund-Pedersen Bente, Kjeldsen-Kragh Jems, Bahr Roald

Norwegian National Sports Center, Norway

*Keywords: immune function, elite athletes, endurance exercise*

We have previously demonstrated that when two bouts of exercise is performed with only a few hours of rest between the exercise sessions, more pronounced changes in immune- and endocrine variables are observed in connection with the second bout of exercise. However, it is not known how the amount of time between two exercise sessions may affect exercise responses to the second bout of exercise on the same day. Thus, the aim of this study was to describe immune related changes during days with 2 bouts of exercise and compare the perturbations induced by a second bout of exercise when the athletes have a long period of rest (6h) vs short period of rest (3h) between the exercise sessions.

Nine elite endurance athletes, participated in three 24 h trials: 1) trial REST with complete bed rest, 2) trial LONG with two bouts of exercise (8:00-9:15AM and 3:15-4:30 PM) separated by 6h of rest, 3) trial SHORT with two bouts of exercise (11:00 –12:15 AM and 3:15-4:30 PM) separated by 3 h of rest. All exercise bouts consisted of a 10 min warm-up followed by 65 min at 75% of V<sub>O2</sub> max on a cycle ergometer. Subjects rested in bed at all hours except when exercising. Blood was collected after 30 min bed rest in the morning, at the end of the 1. exercise bout, 15 min prior to the 2. bout, and then several times during the following 14h recovery period. A two factorial ANOVA procedure for repeated measures with a significance level of 0.05 was used to compare the data



collected during and after the second bout of exercise in trial SHORT with trial LONG.

In the SHORT rest trial, we observed more pronounced increases in concentrations of epinephrine, and neutrophils during the second bout of exercise compared with trial LONG ( $p < 0.001$ , and  $p = 0.002$ ; respectively). During subsequent recovery, there were increased concentrations of cortisol and decreased concentrations of lymphocytes ( $p = 0.013$  and  $p = 0.009$ ; respectively) in trial SHORT compared with LONG. Total oxidative potential of PMA-stimulated circulating neutrophils was higher in trial SHORT compared with trial LONG ( $p < 0.006$ ). Plasma levels of interleukin (IL)-6 and IL-1ra tended to be more pronounced in trial SHORT compared with trial LONG ( $p < 0.084$ , and  $p = 0.079$ ; respectively). Peak values of the neutrophil degranulation products myeloperoxidase (MPO) and human neutrophil lipocalin (HNL) were also higher in trial SHORT compared with trial LONG ( $p < 0.005$ , and  $p = 0.047$ ; respectively). No difference between trials SHORT and LONG was observed for lymphocyte activation (CD69 expression).

In summary, a 3h short rest period between two bouts of endurance exercise resulted in increased stress hormone and interleukin responses, a larger neutrophilia and lymphocytopenia, and a larger oxidative burst and degranulation in neutrophils during and after the second bout of exercise. We suggest that the more pronounced alterations in immune variables are most likely a result of additional neuro-endocrine activation during the second bout of exercise in the SHORT rest trial. Furthermore, such neuro-endocrine activation may be related to lower muscle glycogen content during the second bout of exercise in trial SHORT compared with trial LONG. Finally, the observed perturbations in immune function variables may reflect transient post-exercise changes in the immuno-competence of athletes practicing repeated strenuous training sessions.

#### S111H-4

### Upper respiratory illness in elite athletes and the role of Epstein Barr Virus (EBV)

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**Keywords:** mucosal immunity, salivary IgA, EBV

Upper respiratory tract infections (URTI) are the most common infectious condition affecting athletes undertaking intensive training and account for 30-40% of attendances at sports medicine clinics. Identification of the infection is rarely undertaken and treatment is usually based on a physician diagnosis of associated symptoms. Bacterial and fungal infections are rare and the clinical symptoms are often consistent with infections of viral origin. This has led to speculation regarding the causes of the symptoms and identification of potential inflammatory or infectious agents. The symptoms experienced by athletes while undertaking high-performance endurance training, and loosely called URTI, are consistent with those observed during EBV reactivation. Studies were undertaken to investigate the role of EBV reactivation as an explanation for the upper respiratory symptoms (URS) experienced by elite athletes. The temporal relationships between exercise-induced mucosal immune suppression, the appearance of URS and the detection of EBV reactivation was investigated. The time course of appearance of EBV-DNA in relation to URS suggested that latent viral EBV shedding might be a contributing factor to the URS. The effectiveness of a therapeutic anti-viral agent was investigated in a double-blind, placebo-controlled, cross-over trial. The antiviral agent was effective in reducing the viral load of EBV, however, it did not reduce the incidence of URS. The data suggests that EBV viral reactivation may be associated with symptoms of URTI in some elite athletes, but not in all situations or all sports. Other inflammatory causes of URS need to be considered.

## Oral Session

### Motor Learning

O111I

#### O111I-1

### Multimodal convergent information enhances reproduction accuracy of sport movements

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**Keywords:** multisensory integration, perception-action, audio-visual information

Previous neurophysiological and behavioral research has revealed different areas of multisensory integration in the human cortex (Calvert, 2001). Behavioral consequences of multimodal integration have been described in the field of speech perception: In case the talking face is additionally visible, comprehension of speech is enhanced (Massaro, 1998). But effects of multisensory integration are not limited to speech perception, they also play an important role on cortical representation of space and control of human movement (Andersen, 1997) as well as on the accuracy of movement perception resp. assessment (Effenberg, 2001; i.p.). The aim of our research was to investigate whether multimodal convergent stimuli also affect imitation accuracy of human sport movements under real-world like conditions.

Subjects were asked to watch counter-movement jumps (CMJs) of different heights (60 % - 90 % of individual max.) as video-projections of a model athlete. CMJs were presented in two conditions: Visual treatment (VT, video without sound) and audio-visual treatment (AVT, video with movement-sonification (a continuous electronical sound modulated by the force of the movement)). All subjects heard the movement sonification for the first time. No feedback was given and order of treatment blocks was randomized. Subjects were asked to reproduce the height of each single CMJ observed straight before. CMJs were executed on a Kistler force plate and superelevation of the centre-of-mass (COM) was computed.

The difference between demonstrated and reproduced COM-superelevation was computed for each of the 24 trials. AE shows a significant difference between both conditions (AEVT: 3.17 cm; AEAVT: 2.54 cm) and t-test reaches significance ( $p = .000$ ). Accuracy of reproduction was higher under bimodal convergent stimuli condition, also variance decreased from  $s2v = 0.896$  to  $s2av = 0.342$ .

Results demonstrate that additional convergent auditory information enhances reproduction accuracy of gross motor movements. An enhanced informational base should also support processes of motor learning even as motor memory.

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Calvert, G.A. (2001). *Crossmodal Processing in the Human Brain*. *Cereb Cortex*(11), 1110-23.

Effenberg, A.O. (2001). *Multimodal convergent information enhances perception accuracy of human movement patterns*. ECSS, Cologne.

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Massaro, D.W. (1998). *Perceiving Talking Faces*. Cambridge, M.

## O111I-2

### Motor control in walking - age dependent differences in cognitive structures between adults and seniors

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**Keywords:** motor control, cognition, mental representation

Walking is crucial for our mobility and the development of our environment. Because of this importance for daily life and the easiness with which measurements of the stable movement cycles can be performed, the gait has become one of the best examined movements. Interestingly there are no studies in cognitive science dealing with cognitive structures as a basis for the movement organization of the gait. Our first aim was to follow up the question whether existing cognitive structures in walking deteriorate during the life-span or not. In particular the analysis with regard to the elderly pose a great challenge, since the increase of faults in walking causes falls with serious injuries at this age.

Totalling we used three methodological approaches. Firstly we used the structural-dimensional analysis of motor-memory (SDA-M) to gain information about the cognitive structure in motor memory. It also provides the possibility to register individual and inter-individual differences by means of an invariance measure (Schack 2001). The second approach was a modified Tinetti-test (Tinetti 1986) to compare the results of the first approach with a common clinical gait-assessment for the elderly. Thirdly we used an anamnestic questionnaire for additional information. In order to obtain a differentiated statement for the relation of age and the cognitive structure, we choose our subjects (N=21) on different age-levels.

The results of the cluster- and factor-analysis show a chronological and functional ordered cognitive structure. Furthermore, it could be shown that the cognitive structure changes with age. It is strongly dependent to the individual conditions of the subject, e.g. specific injuries and the physical health. The differences between the groups represent the problems in walking of some elderly which could also be diagnosed by the Tinetti-test and are prescribed by the subjects in the questionnaire.

Therefore, it should be possible to structure an individualized mental-training. First experiences for a transformation of this geriatric training concept have already been made.

Schack T (2001). *Mot. C. And Learn. E-Journal*. 1-12. <http://ites.orbis-communications.de/recherche/index.asp>

Tinetti ME (1986). *Journal of the American Geriatric Society*, 43: 119-126

## O111I-3

### The risk of unintentional firearms discharge

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**Keywords:** motor control, firearms, reflex

In the past few years an increasing number of people have been injured, sometimes fatally, as a result of police-weapons being discharged unintentionally. Analysis of unintentional discharge incidents indicates marked congruities between different incidents and points to three recurring factors: i) sudden loss of balance, ii) use of other limbs and iii) startle reaction, lending support to the theory that interlimb reflexes may play a part in such accidents.

A pistol was fitted with force sensing resistors on hand-stock and trigger. In a serie of trials, 25 participants performed 13 different motor tasks while holding the weapon in their hand. Force values recorded on the weapon during the trials were set in relation to the values recorded when holding the weapon without performing an additional movement. To determine if the force exerted on the gun would have been sufficient to release a shot, individual release values for each participant were set in relation to the maximum force-loads registered.

An increase in force exerted on the weapon was registered in all trials. Bonferonicorrected t-tests indicated significant increases in 11 of 13 cases for the mean and 12 of 13 cases for the maximum values registered on the hand-stock, indicating that activity in other limbs does indeed lead to an increase in the amount of pressure exerted on a firearm. Comparison of individual release values with maximal forces attained by participants during the trials shows that the pressure exerted on the weapon as a result of activity in another limb can be, in many cases, sufficient to unintentionally discharge a weapon.

The results lend empirical support to the theory that motor activity in different limbs can lead to a significant increase in grip force exerted on a firearm and thus to an unintentional discharge of a firearm. It is proposed that future research should concentrate on means of reducing the danger. Further analysis of the data collected in this study i) offers first indications as to which movements carry the highest risks of enhancing the force production in the hand holding the weapon and ii) indicates that specific training can influence the interrelation of reflexes between limbs and may help reduce the risk of discharging a firearm unintentionally.

## O111I-4

### Activation of motor and related areas during observation and mental imagery of gymnastic movements: an fMRI study

Zentgraf Karen, Reiser Mathias, Künzell Stefan, Stark Rudolf, Walter Bertram, Vaitl Dieter, Munzert Jörn

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**Keywords:** mental imagery, observation of human movements, fMRI

Recent fMRI-based studies suggest a mental network integrating brain areas for motor action and observation of biological motion with the purpose of imitation (Chaminade et al., 2002). Jeannerod (2001) proposes a mental simulation theory by classifying imagery and observation as covert stages of action without execution. In this study, we investigated the neural correlates of covert stages of action and different observation modes (Grèzes et al., 1998) that are typical for sport situations by using gymnastic sequences.

We studied BOLD-contrast changes with fMRI in motor and related areas during observation and mental imagery of whole-body gymnastic movements. Additionally, we compared two observational situations in sports: observation for imitation and for movement evaluation.

Ten female P. E. students who were able to generate vivid images of movements were shown different video sequences of 14-22 s duration. In the evaluation condition, subjects observed the sequence in order to judge the constancy in motor performance. In the imitation condition, subjects were instructed to use the observed movement sequence as a content for their imagery. In the mental imagery condition, subjects performed a mental imagery of the observed sequence. In the control condition, subjects fixated a static cross on the screen. Video material was identical in the observational conditions; they were performed in randomized order.

The results show that covert stages of action have equivalent cortical components. However, areas not primarily and solely associated with motor processes (e. g., frontal areas, insula, and cingulate gyri) show differential activation due to task differences. Top-down processing differences for the observational modes are related to premotor areas, cerebellum, basal ganglia, and BA 40. These results support the view that motor areas are involved in motor tasks not requiring motor execution, but additional, differential non-motor areas are recruited when performing specific covert motor tasks such as observation or mental imagery.

*Chaminade, T et al (2002). Does the end justify the means? A PET exploration of the mechanisms involved in human imitation. NeuroImage, 15: 318-328*

*Grèzes, J et al (1998). Top-down effect of strategy on the perception of human biological motion: a PET study. Cognitive Neuropsychology, 15: 553-582*

*Jeannerod, M (2001). Neural simulation of action: A unifying mechanism for motor cognition. NeuroImage, 14: 103-109*

#### O1111-5

### Cognitive representation of complex movements in motor memory - a study in alpine freestyle ski

**Schack Thomas**

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*Keywords: motor control, cognition, mental representation*

As we know from numerous studies, coaches (as experts) and beginners often do not use the same information at a certain stage of motor learning. E. g. the athlete develops an "intuitive" feeling for the water, a "feeling for movement" etc. and the originally applied instructions are no longer valid for the cognitive structure of the learning athlete. Such divergences within the coach-athlete-interaction represent a specific reason to get a closer insight into the construction and change of cognitive structures in complex movements.

In former studies concerning cognitive representation in sport, self-reports were carried out either verbally or in written form (interviews, questionnaires, thinking aloud, card sorting tests, etc.). These methods, however, reveal a number of problems, particularly concerning objectivity and reliability (Thomas & Thomas, 1994). We therefore relied on an experimental procedure called structural dimensional analysis of motor memory, (SDA-M). This procedure provides the possibility to register individual changes in learning by means of an invariance - measure. Also observations concerning interindividual differences and statements concerning group-related differences (experts/novices) can be made (Schack, 2001).

By using an expert-beginner paradigm, differences in the quality of the structure and organisation of knowledge between experts and beginners in this special movement were found. It is shown that, in contrast to beginners, the mental structure of persons with a high ability to perform is more differentiated and more strongly function-orientated. By means of an invariance measure (of the SDA-M-method), a significant difference between mental structures of experts (N=15) and novices (N=12) in this special complex movement were found.

Experts obviously are better able to apply their knowledge practically to aim for an optimal execution of the movement. Furthermore, statements concerning cognitive structures are given, which are of immediate relevance for training processes. Based on these statements the coach is more able to decide the cognitive context which athletes can understand and work on.

*Thomas KT, Thomas JR (1994). IJSP, 30 (2), 221-234*

*Schack T (2001). Mot. C. and Lern. E-Journal.*

#### O1111-6

### High speed scanning in movement based memory - experimental studies in gymnastics

**Heinen Thomas, Schack Thomas**

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*Keywords: gymnastics, scanning, short term memory*

When analysing sport techniques, perception and memory processes become important in understanding on how the athlete controls the movement. Further studies hint at differences in memory processes between athletes and non-athletes (Heinen & Schack, in press; Schack, 2000). The main focus of this study lay on the question how gymnasts in difference to non-gymnasts are able to optimise their information processes in short term memory (STM). It is subsidiary presumed, that a specific movement based knowledge (long term memory) about a gymnastic technique can influence information processes in STM.

The Sternberg-paradigm has proved itself as an important paradigm for analysing information-processing in short term memory (Sternberg, 1969). For testing movement based memory resources, Sternberg's approach was further modified (Schack, 2002). The so called CMC-paradigm (cognition and movement chronometry) consists of a binary recognising task. The logged reaction times for every binary decision can be interpreted according to comparison processes in STM (Sternberg, 1969; Schack, 2002). Subsidiary a long term memory test (SDA-M) was carried out for the gymnasts (Heinen & Schack, in press).

When analysing the data from the CMC-paradigm the classical Sternberg results can be confirmed for non-categorical material. When looking at the one-categorical material (gymnastic techniques) the reaction times follow a more logarithmic course for gymnasts with an additional amount of pictures to memorize but stay linear for the non-gymnasts. When looking at the SDA-M-data of the gymnasts, connections between the reaction times and structural parameters of the mental representations in long term memory could be found.

The results from the CMC-data indicate, that gymnasts use different comparison processes in STM than non-gymnasts for sport-specific material. The logarithmic course of the reaction times indicate in addition that gymnasts use specific chunking processes. Applied to the gymnasts knowledge about the movement, comparison processes in short term memory may be pre-structured. This movement based

chunking helps to optimise short term memory processes, which can be useful for carrying out movements successfully.  
 Heinen T, Schack T (in press). *Messplatz Mentale Repräsentationen im Sport*  
 Schack T (2000). *Experimental Studies. J Sp. & Exc. Psychology*, 22: 94

Schack T (2002). *Kognitive Architektur von Bewegungshandlungen*  
 Sternberg S (1969). *American Scientist*, 57: 421-457

## Oral Session

### Physiology 4: Endocrinology

O111J

O111J-1

#### Resistance exercise-induced hormonal response in men and pubescent boys following an unaccustomed resistance exercise bout leading to DOMS

Pullinen Teemu, Mero Antti, Huttunen Pirkko, Pakarinen Arto, Komi Paavo

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**Keywords:** children, muscle damage, hormones

We have recently found (Pullinen et al. 2002) that the levels of cortisol (COR) and growth hormone (GH) may be blunted in adult men in a resistance exercise bout performed two days after an identical exercise bout leading to a delayed onset of muscle soreness (DOMS), an indirect indicator of muscle damage. The few studies that have examined exercise-induced muscle damage in children suggest that the muscular disturbance is less severe compared to adults (Duarte et al. 1998, Soares et al. 1996). The purpose of the present study was 1) to confirm our earlier results regarding the attenuation of COR and GH levels in adult men, and 2) to examine whether the attenuation is lower in pubescent boys. Eight physically active men and eight pubescent boys performed two identical exhaustive knee extension exercise bouts (E1 and E2) with 48h of rest in between. Blood was sampled for the determination of the hormone levels, creatine kinase activity (CK), lactate (LA), haemoglobin (Hb) and hematocrit (Hcr). Maximal isometric contraction force (MVC) was determined before and after the exercise bouts. CK increased from E1 to E2 both in men and in boys ( $p < 0.05$ ). DOMS peaked in boys one day and in men two days after E1 and declined thereafter. Total number of repetitions performed, plasma volume change, LA response and the MVC decline did not change from E1 to E2 in either group. No changes were also observed in the levels of any of the hormones in boys. In men the overall level of COR (including the pre-exercise level) was lower in E2 than in E1 ( $p < 0.05$ ), as well as the concentrations of adrenaline (A) and GH after the three exercise sets ( $p < 0.05$ ).

The present results suggest that an acute resistance exercise bout may lead to a decreased level of COR, GH and A in the following exercise bout in adult men. This attenuation may be related to the process of muscle damage, as it could not be found in pubescent boys who in general seem to experience less muscle soreness than adults. However, the actual mechanisms explaining the blunted response are unclear. In further studies e.g. the inflammatory cytokines and other systemic factors as well as muscle damage related insulin resistance could be examined as potential contributors to this phenomenon.

Duarte JA et al (1999). *Int. J. Sports Med.*, 20: 103-108

Pullinen T et al (2002). *J. Strength Cond. Res.*, 16: 383-389

Soares JMC et al (1996). *Ped. Exerc. Sci.*, 8: 361-367

O111J-2

#### Energy expenditure during triathlon training on top performance level correlates time-lagged with serum IGF-I: A single case time series analysis

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**Keywords:** energy expenditure, IGF, time series

Longitudinal studies investigating the variability of serum GH and IGF-I hormones at high-endurance loads are very rare.

In order to study the relation between energy expenditure and IGF-I, a triathlete (longdistance) was investigated in a time series analysis of 5 months. Physiological characteristics of the male triathlete of high international Ironman-level for age, weight, height and maximal oxygen uptake ( $\text{VO}_{2\text{max}}$ ) were: 27 yr; 86.65  $\pm$  1.17 kg; 188 cm; 76 ml/min/kg. The longitudinal study started at the end of the seasonal training break with a 2-week baseline determination and ended after a training camp. Blood samples were collected for the determination of parameters of the metabolic and the endocrine system daily during the baseline, and in the training phase 3 times per week.

The following parameters were measured daily: energy expenditure, body weight and resting heart rate. Performance diagnostics were conducted once per week. Total energy expenditure of the athlete during the training phase, without the basal metabolic rate, was on average 10011  $\pm$  5481 kJ. Both thresholds in cycling (aerobic 220-303W (+37%), anaerobic 291-356W (+22%)) and running (aerobic +36%, anaerobic +25%) were improved, following increasing energy expenditure during triathlon training. Body weight (-5%) and resting heart rate (-7%) decreased significantly during the study as well as serum values of IGF-I. The results of cross correlation analysis between energy expenditure and IGF-I showed a significant negative correlation up to a time lag of 4 days. A clear trend with biological inphase calibration could be observed at the beginning of the study, followed by a significant counterphase relation within 3-5 days.

Further studies are necessary to clarify whether an increase in training load causes a decrease in serum IGF-I, or whether there are also other parameters that affect these two values.

Dércole A J and, Calikpoglu A S (2001). *Growth Hormone & IGF Research*, 261-265.

Adams G R (2000). *Br J Sports Med* 343, 412-413.

## O111J-3

**Neuroendocrine changes in overtraining: a case presentation of an amateur long-distance runner**

**Buyse Luk, De Schutter Guy, Meeusen Romain, Kempnaers Farid, De Meirleir Kenny, De Geus Bas**

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*Keywords: overtraining, testing, neuroendocrinology*

Several signs and symptoms in overtraining are associated with imbalance between training and recovery. Reliable diagnostic markers to distinguish well-trained, overreached and overtrained (OTS) athletes lack. We developed a "two exercise test" (2ExT) to detect subtle differences in neuroendocrine response in athletes of different training/overtraining status. We report the use of the 2ExT in an athlete with clinical diagnosis of OTS. He is tested at diagnosis and 5 months later, recovered from OTS. This 2ExT confirms the clinical OTS diagnosis and evaluates given treatment.

The marathon runner (best time 2h45') shows gradual performance deficits, disturbed sleep and increased morning heart rate. He shows symptoms of depression and is treated with an SSRI and a benzodiazepin at both occasions. He is tested in overtrained status (OTS) and after recovery (REC). The 2ExT consists in two maximal incremental exercise tests separated by 3 hours. Blood samples are collected before and after each test and analyzed for cortisol (COR), growth hormone (GH) and prolactin (PRL). After the first test session, training was reduced dramatically (120 to 40 km/wk). At the time of the second 2ExT, he clinically recovered from his overtrained status but still mentioned symptoms of depression.

The neuroendocrine responses to the second exercise test are different between OTS and REC. We observe a normal neurohormonal reaction to the 2ExT in the recovered status, but an obvious maladaptation mainly to the second bout of exercise in the overtrained status. The differences include a much greater PRL response to the first test and a suppression in the second, a normal reaction of GH after the first bout of exercise, no recovery after 3h of rest and a suppression of GH after the second test. We notice also a delayed increase in COR such that COR is not elevated in response to the second test in the OTS situation compared to R.

These results support existing evidence of an altered and dysfunctional hypothalamic-pituitary axis response to two bouts of maximal exercise in an overtrained athlete. They indicate that a 2ExT can be used to develop markers for diagnosis of OTS and to begin to address the pathological mechanisms operative in OTS, as well as provide a clinical tool to evaluate possible therapeutic regimes.

## O111J-4

**Age effect on saliva testosterone, cortisol, and testosterone-to-cortisol ratio after a triathlon**

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*Keywords: testosterone, cortisol, age*

The levels of testosterone and cortisol have been used as the indicators of anabolic and catabolic status in the body, respectively. An equilibrium between anabolic and catabolic

states is often represented by the ratio of these two hormones, the testosterone-to-cortisol (T/C).

Saliva testosterone and cortisol have been suggested to represent the biologically active forms of the respective hormones.

This study investigated the age effect on acute responses of saliva testosterone, cortisol, and T/C after a triathlon.

Thirty-one male subjects were divided into 3 age groups: group 1 (under 40 years), group 2 (41-50 years), and group 3 (above 50 years). Saliva testosterone and cortisol concentrations were measured by radioimmunoassays.

Prior to the race, group 3 had significantly lower cortisol and higher T/C than the 2 younger groups.

Cortisol increased after the race in all age groups, with significance found in group 2. The race-induced declines in T/C were significantly larger in group 3 than in the 2 younger groups.

To our knowledge, this is the first study of the age effect on acute responses of testosterone and cortisol after intensive endurance exercise. Despite the small sample size, we discovered that the oldest group had significantly larger decline in T/C after the race than the 2 younger groups.

The results suggested that the older subjects may be under higher physical stress and greater imbalance between anabolic and catabolic states than the younger after a triathlon.

## O111J-5

**Effect of prior drop jumps on the VO<sub>2</sub> kinetics during exercise near or above lactate threshold**

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*Keywords: lactate threshold, oxygen uptake, drop jump*

The aim of this study was to examine the influence of prior drop jumps on VO<sub>2</sub> kinetics during exercise near or above lactate threshold (LT).

Seven Physical Academy students (age 23.9±2.0 yr, height 178.6±6.9 cm, and weight 71.9±11.2 kg) volunteered to participate in this study. Subjects completed two protocols. During the first day they performed intermittent increasing cycling exercise (ICE) and after 15 min of rest - the continuous increasing cycling exercise (CCE). In the second examination the subjects performed one hundred drop jumps at maximal intensity every 20 s (DJ), rested for one hour and then performed the ICE. The ICE consisted of 6 min work and 4 min passive recovery periods. The first WR was set at 70 W and was increased by 35 W during each consecutive work period. Testing was performed on mechanically braked cycle ergometer (Monark 834E) while cycling at 70 rpm. At the end of each 6 min work stage, a blood sample was collected from the fingertip for immediate analysis of blood lactate concentration ([La]). In the CCE the WR from 70 W was increased by 25 W every minute until the subjects reached volitional exhaustion. Pulmonary gas exchange was measured breath-by-breath. VO<sub>2</sub> peak was determined as the highest value in 15 s period before the subjects' volitional termination of the CCE. The VO<sub>2</sub> response during exercise and recovery periods of ICE was fitted the mono-exponential function. In addition the slow component was calculated as the difference between the end exercise VO<sub>2</sub> and the 3rd min VO<sub>2</sub>. The LT was determined as a sustained increase in [La] above resting level during ICE.

The mean VO<sub>2</sub> peak of the subjects was 3.59±0.63 l/min or 50.16±6.44 ml.kg<sup>-1</sup>.min<sup>-1</sup>, with LT averaging 51.7±5.3 % of

VO<sub>2</sub> peak. To compare the VO<sub>2</sub> parameters between testing conditions (without and after DJ) data were normalized to each individual's LT. The VO<sub>2</sub> values achieved during the <LT and >LT exercise were 41.0±4.2 % and 66.0±10.2 %, respectively. Prior DJ had no effect on time constants of VO<sub>2</sub> response during on- and off-transition. The VO<sub>2</sub> values at the 6th min of exercise at all intensities were significantly elevated after DJ.

The prior DJs caused the elevation of VO<sub>2</sub> steady state levels during exercise near or above LT. This may be associated with morphological, metabolic and functional changes in muscle after heavy stretch-shortening cycle exercise.

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#### O111J-6

### The influence of extension rate on slow component of VO<sub>2</sub> during a local exercise of dynamic shoulder extension

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**Keywords:** EMG, slow component of oxygen uptake, contraction velocity

There are conflicting results whether the slow component of VO<sub>2</sub> (VO<sub>2</sub>SC) is related to increased neuromuscular activity (1,2,3,4). Examination of a few numbers of muscles or the selection of exercises that involve movements in several articulations might be responsible for the between-studies discrepancies. In order to test the hypothesis that VO<sub>2</sub>SC is associated with the increase in neuromuscular activity of the working muscles, we used a device built to elicit a small muscle mass of the upper part of the trunk (shoulder-extensor muscles) in the present study. We used an indirect approach which consisted in a modification of the shoulder extension rate to alter the neuromuscular activity.

8 specialists in activities implying the upper limbs performed a series of constant poweroutput exercise tests (amounting to 70 % VO<sub>2</sub>max) for 8 min at shoulder extension rates of 30 and 50 cpm. The VO<sub>2</sub> response was fit with a model including three exponential functions. Neuromuscular activity was evaluated for four right muscles (Latissimus Dorsi (LD), Deltoideus posterior (DP), Triceps Brachii (TB), Rectus abdominis (RA)) on the basis of an integrated electromyogram slope (iEMG slope in arbitrary units, Ua) defined by the changes in iEMG as a function of time between the 3rd minute and the end of the exercise.

The magnitude of VO<sub>2</sub>SC was significantly reduced at 50 cpm (214 ± 112 ml.min<sup>-1</sup>) compared with 30 cpm (377 ± 177 ml.min<sup>-1</sup>). For the smallest rate only (30 cpm) iEMG increased significantly in the DP and LD muscles. Considered the whole extension rates, results showed a significant correlation between magnitude of VO<sub>2</sub>exc and iEMG slope determined from DP and LD ( $r = 0.5$ ;  $P < 0.05$ ).

The findings of this study demonstrate that high contraction velocity reduced the magnitude of VO<sub>2</sub>SC during an exercise executed at the same external power output. Results suggested that the greatest magnitude of VO<sub>2</sub>SC might be partly related to the higher rise of iEMG. Nevertheless, we observed VO<sub>2</sub>SC among some subjects without a change in iEMG from the studied muscles. Therefore it was concluded that VO<sub>2</sub>SC might exist without any change in neuromuscular activity in the main working muscles.

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## Symposium

### Testing and Training

S112A

## S112A-1

#### Tests and testing endurance capacities - validity and reliability of test results

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*Keywords: energy supply, performance diagnostics, physiology*

During performance diagnostics, the physiological capacity is defined due to the three energy supporting metabolic reactions. In accordance with these results, further conclusions are drawn concerning training monitoring and training methods and detailed proposals given for further training.

During endurance testing in a laboratory a stepwise increasing test is performed (3 min step duration, 1 min rest, increase each step 50 watts or 0.5 m/s) normally. The decisive parameters for interpretation are the "endurance capability" / "anaerobic threshold" (AT), the maximum power output during exhaustion (Pmax), the maximum lactate concentration after work-load, the cardiac-rate and parameters of the gas-exchange-metabolism. From determination of the AT the so called "aerobic capacity" is estimated, and from measuring Pmax the "anaerobic capacity" is indicated. Both assumptions are incorrect which will be explained by the use of a simulation model. It can be concluded that many of the common laboratory test proceedings and the way they are used for interpretation do not fulfill the basic quality criteria of valid and reliable performance testing procedures. A more specific test scheme would be necessary for a differentiated interpretation. Another problem is, that there is only a description of training contents and of some parts of competition load in physically orientated sports. These will then be defined and practices in this way. The insufficient result can also be seen in how the terminology of "training science" is used in practice and in particular practice aims and methods. This is also caused by the dominant phenomenological and traditional description of the performance demand without much respect to biology. - By means of the computer-based simulation programs of given loads all the inadequacy and limits of some reports and conclusions as well as their simple transferability into training practice can be shown. Further it will be discussed that a high performance in competition can be explained by different metabolic patterns. Based on those explanations, possible maladaptations can be understood more easily.

Many assumptions in test interpretation and in sport training are made without regarding the complex dependence of each energy-producing/metabolic reaction due to work-load duration and intensity, without an interpretation of the complex process inside the muscle and very often without a sufficient explanation in adequate theoretical concepts.

## S112A-2

#### Calculated evaluation of individual metabolic capacities from lactate performance tests in endurance related events: A simplified basic mathematical approach

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*Keywords: energy supply, performance diagnostics, physiology*

Evaluation of the aerobic and anaerobic metabolic capacities is based on the determination of the "anaerobic threshold" (AT), the VO<sub>2</sub>max and the estimation of the "anaerobic capacity". The interpretation of the test results is commonly believed to be a matter of personal experience oriented on published experimental results. However, the traditional type of evaluation lacks a clear and consistent theoretical base how the energy delivering metabolic mechanism are interacting together.

The simulation patterns are due to the difference of 3 components of ATP supplying reactions in the working muscle mass: 1. the concentration of creatine phosphate ([PCr]) (~alactic work capacity), 2. the content of mitochondria which determines the maximum of aerobic ATP production rate (aerobic power (~VO<sub>2</sub>max (ml/min\*kg)) and 3. the maximal glycolytic ATP-production rate (lactic power (~VLamax (mmol/s\*I))). To apply to the human body the active muscle mass (25% to 35% of body mass) and the lactate distribution space (35% to 45% of body volume) have to be considered. As it is for practical purpose too complicated to re-simulate experimental results of the individual pattern of test results a simplifying of the mathematical approach without a loss of accuracy is needed. The simulation model calculates the activation of glycolysis and oxidation as a function of the decrease of the status of phosphorylation of the cytosolic ATP/PCr system of the muscle cell. The decrease of the phosphorylation results from the energy needs of muscle contraction and basic (resting) metabolism. For the activation of the metabolic procedures equations on basis of the HILL-equation are defined. The phosphorylation-balance in the ATP/PCr system is calculated by algebraic equations. Theoretical base of the simulation is a system of non linear differential equations and other algebraic equations which are embedded in a numerical Runge-Kutta processing of 5th grade.

The conclusion is that it is by no means possible to estimate directly from an athlete's aerobic and anaerobic metabolic capacity. A consistent theoretical concept is inevitable to evaluate indirectly from the results of a combination of a step test and a supra maximal 1 to 3 min lasting exhaustive test the components of metabolic power of athletes.

## S112A-3

**Application of a theoretical metabolic calculation model in field tests and its implication on training periodisation and monitoring****Olbrecht Jan**

Artevelde-Institute of Higher Education, Belgium

*Keywords: swimming, performance diagnostics, training monitoring*

Lactate tests are still subject of controversies, mainly due to the use of non-scientific and unvalidated interpretation methods. Mader et al. described a model that enables us to understand the metabolic processes leading to post exercise blood lactate concentrations.

Mader's theoretical model was used to simulate by means of lactate measurements VO<sub>2</sub>max and VLamax, the maximal lactate production capacity. The outcomes of this method were confronted with those of the common interpretations methods based on the outward of the lactate curve (LC).

For 13 runners performing submaximal field tests, measured and simulated values correlated highly for post exercise blood lactate ( $r=0.991$ ) and VO<sub>2</sub> (K2-Cosmed,  $r=0.907$ ). In 686 swimmers both the 4mmol/l swimming speed on 400m (V<sub>4</sub>) significantly correlated with VO<sub>2</sub>max ( $r=0.63$ ) and the highest lactate after a 100m all-out (Lamax) with VLamax ( $r=0.36$ ). Huge deviations however did not allow any accurate predictable outcome from V<sub>4</sub> and Lamax towards VO<sub>2</sub>max and VLamax. Qualitatively, changes in V<sub>4</sub> matched in only 57% of the tests with those of VO<sub>2</sub>max. This indicates that the outward of a LC is not only a consequence of VO<sub>2</sub>max but also of VLamax. The determination of both parameters is not only crucial for framing right training objectives, but also for fixing correct intensities. In 38 elite rowers, the %VO<sub>2</sub>max for the same lactate decreases when VLamax increases. This may be favourable to avoid overload in training, but will have a negative impact on the performance in long distance events. This is reflected by the negative impact of VLamax on %VO<sub>2</sub>max at MaxLass. Consequently, one must consider a well balanced build up of VO<sub>2</sub>max and VLamax (aerobic and anaerobic capacity) during the build up phase of the periodisation and define the length of the competition preparation phase according to the time needed to bring VO<sub>2</sub>max and VLamax in an optimal balance for the competition event.

We can conclude that (1) Mader's theoretical metabolic model can be used to estimate VO<sub>2</sub>max and VLamax in field tests, (2) both estimations are of primary importance to monitor training and (3) an assessment of the metabolic performance directly derived from the outward of LC is erroneous.

## S112A-4

**Should metabolic parameters be integrated with mechanical parameters to optimise training monitoring?****Faina Marcello**

CONI - Institute of Sport Science, Italy

*Keywords: monitoring, external loads, internal loads*

Coaches were used to classify training intensity based on the training methods employed such as repeats or distance or speed or time (the so called external work). However these means may not always provide an accurate assessment of the metabolic stress experienced by an athlete (the so called internal work). Therefore practical means of monitoring training intensity, as heart rate (Hr) and blood lactate (BL), are widely used to this extent. However Hr and BL reliability is questionable, as a valid mean to monitor training intensity. In fact both Hr and BL can be affected by several factors such as fitness, environmental factors, duration of performance, thermal shift, nutrition, glycogen concentration, etc, rather than the energy cost of performance alone.

In addition to this some other factors could affect the reliability of Hr and/or BL. In fact, training and performance work load does not consist of metabolic stress only, but it includes the mechanical stress on muscle fibers also. Actually, in 1960 Christensen did already demonstrate that changing the exercise/rest ratio of test carried out at the same mechanical power (i.e. velocity), metabolic parameters, as V'O<sub>2</sub>, Hr and BL changed significantly. During actual competition muscle fibers are required to produce mechanical power, which is seldom produced at constant rate, even in long distance competition, as cycling or cross country skiing (it has been shown that road cycling consists of several short or very short variations of pace). In such conditions Hr may easily underestimate the true work load. It can be concluded that in some conditions, as in intermittent training, Hr cannot be considered a reliable mean to monitor training load or at least could not be really representative of the actual training load.

Moreover even when performance or training is performed at constant power, there could be some differences in the rate of fibers recruitment. In such conditions adaptations induced by training are quite different and they cannot be monitored by detection of Hr and BL alone. All these observations mean that Hr and/or BL should be considered only as piece of information, even not a secondary one, along with others records of training, as, above all, the external load. The latter could be detected by technological devices, now available to measure mechanical power in several sports, as cycling, rowing, cross country skiing, canoeing etc



## Oral Session

## Physiology 5: Muscles and Tendons

O112B

## O112B-1

**Tendon adaptations to strength training in old age****Reeves Neil, Maganaris Constantinos, Narici Marco**

Manchester Metropolitan University, United Kingdom

*Keywords: training, tendon, aging*

Ageing is associated with a reduction in tendon tensile stiffness (Noyes & Grood, 1976), but animal studies suggest that tendons become stiffer in response to increased loading (Woo, et al., 1980, Woo, 1982). However, it is unknown whether elderly human tendons are capable of adapting similarly. Therefore the aim of this study was to investigate the effects of 14-weeks strength training on the viscoelastic properties of the patella tendon in elderly individuals. Participants were assigned to either training (age  $73.6 \pm 3.4$  years, body mass  $69.4 \pm 17.7$  kg and height  $162 \pm 10.7$  cm, mean  $\pm$  SD;  $n = 7$ ) or control (age  $66.4 \pm 1.7$  years, body mass  $72.5 \pm 16.4$  kg and height  $166.2 \pm 12.1$  cm;  $n = 7$ ) groups. Training consisted of 2 series of 10 repetitions of leg-extension and leg-press exercises (Technogym, Italy), at 80% of the 5-repetition maximum (5 RM). Patella tendon forces were calculated from joint moments and magnetic resonance imaging-based estimates of tendon moment arm length. Measurements of tendon elongation were performed in vivo using ultrasonography (ATL, USA) during a maximal isometric knee-extension contraction-relaxation, using previously applied methods (Maganaris & Paul, 2000). Tendon stiffness was calculated from the gradient of the force-elongation relation over 60-100% of maximal tendon force and hysteresis was calculated as the area between loading-unloading curves. The rate of torque development (RTD) was assessed as the slope of the torque-time curve during a rapid contraction. Maximal isometric tendon force increased by 20% after training (pre:  $2916 \pm 992$  N; post:  $3484 \pm 1249$  N;  $P < 0.01$ ) and decreased by 16% in the control group (pre:  $3375 \pm 1231$  N; post:  $2843 \pm 934$  N;  $P < 0.01$ ). Tendon stiffness increased by 64% (pre:  $1376 \pm 811$  N.mm<sup>-1</sup>; post:  $2256 \pm 1476$  N.mm<sup>-1</sup>;  $P < 0.01$ ) and hysteresis decreased by 28% following training (pre:  $33 \pm 5\%$ ; post:  $24 \pm 4\%$ ;  $P < 0.05$ ). The RTD increased by 27% after training (pre:  $483 \pm 303$  Nm.s<sup>-1</sup>; post:  $613 \pm 401$  Nm.s<sup>-1</sup>;  $P < 0.01$ ). In contrast, no changes were observed in stiffness, hysteresis or RTD in the control group ( $P > 0.05$ ). The training-induced alterations in tendon viscoelastic properties are likely to have contributed to an increased RTD and have implications for maximal muscle force production and metabolic energy saving during locomotory activities, in elderly humans.

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## O112B-2

**Changes in levels of matrix metalloproteinases and their inhibitors in human tendinous tissue after exercise****Heinemeier Katja M, Koskinen Satu, Olesen Jens L, Langberg Henning, Kjær Michael**

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*Keywords: exercise, tendon, matrix metalloproteinases*

Metabolism of type I collagen has been found to be influenced by mechanical stress in several tissue types. In line with this, microdialysis studies indicate that mechanical loading of human tendon tissue during exercise/training can affect local synthesis and degradation of type I collagen. Degradation of collagen and other extracellular matrix proteins is controlled by an interplay between matrix metalloproteinases (MMP's) and their inhibitors (TIMP's). However, it is unknown whether local levels of MMP's and TIMP's are affected by tendon loading in humans in vivo.

In the present experiment, six healthy young males performed 1 hour of uphill (3%) treadmill running. In order to monitor local changes in MMP's and TIMP's in the Achilles tendon, dialysate was collected from microdialysis probes (placed in the peritendinous tissue immediately anterior to the Achilles tendon) before, immediately after, 1 day and 3 days after the exercise bout. Pro-forms of MMP-2 and MMP-9 were measured in dialysate by gelatine zymography and amounts were quantified by densitometry in relation to total protein content in the dialysate. TIMP-1 and -2 were analysed by reverse gelatine zymography and semi-quantitated visually.

Pro-MMP-9 increased markedly after exercise (4 fold increase,  $P < 0.05$  vs basal) and remained high for 3 days post exercise ( $p < 0.05$  vs basal). Pro-MMP-2 dropped to ~50 % of the basal level immediately after exercise ( $p < 0.05$ ) and remained low on day 1 ( $p < 0.05$  vs. basal), but was slightly elevated at day 3 ( $p < 0.05$  vs basal). The inhibitory activity of TIMP-1 was clearly elevated 1 and 3 days post exercise ( $p < 0.05$  vs basal) and TIMP-2 activity rose on day 1 after loading.

The present findings demonstrate enhanced interstitial amounts of MMP's and TIMP's after exercise in the human peritendinous tissue in vivo, and the magnitude and time pattern of these changes may well indicate that matrix metalloproteinases and their inhibitors are playing a differentiated role in ECM adaptation to exercise in tendon tissue.

## O112B-3

**Effect of immediate protein-containing energy-supplementation following every training session on skeletal muscle adaptation to 12 weeks of heavy resistance training**

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**Keywords:** ACL, rehabilitation, hypertrophy, protein supplementation

Patients with anterior cruciate ligament (ACL)-deficiency have significant laxity of the injured knee, which restrain their use of the leg resulting in especially quadriceps muscle (Q) atrophy of the injured leg. Such ACL-deficient patients need muscle-rebuilding rehabilitation as well as balance and stability training. Heavy resistance exercise (HRE) is potent to improve muscle protein turnover, which is basis for increasing muscle mass when repeated over time. Further, a positive acute effect of protein-containing energy-supplementation following one session of HRE on muscle protein turnover has been found in several studies. However, the effect of immediate food intake following every training session in subjects training over a period of time has not been investigated extensively. Therefore we investigated the longitudinal effects of protein-containing energy-supplementation following every HRE session on muscle mass and morphology on ACL-deficient patients.

16 ACL-deficient subjects conducted 36 sessions of supervised HRE targeted towards the quadriceps muscle (Q). Each subject was randomly assigned into one of two groups, receiving either protein and energy (PE) or non-caloric placebo (NON) supplementation immediately after each training session. No other intake was allowed 2h before and 2h after every training session. Measurements were conducted before and after the 36 training sessions.

Both PE and NON increased Q-anatomical cross sectional area (ACSA) at all three locations determined by magnetic-resonance imaging. At distal location PE tended ( $p < 0.10$ ) to increase Q-ACSA more than NON, 24% vs. 8%, respectively. The fibre pennation angle of the vastus lateralis head of Q increased significantly by 18% in PE only.

Preliminary results from this study indicate that intake of protein-containing energy-supplementation following every single HRE session has a significant effect on increments in muscle mass following repeated training/supplementation sessions when compared to controls that became placebo supplementation following every training session.

## O112B-4

**Effect of exercise induced hyperthermia on neuromuscular drive**

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**Keywords:** hyperthermia, central fatigue, neuromuscular control

Recent evidence suggests the relationship between attenuated physical work and elevated body temperature ( $T_c$ ) may be due to a reduced neuromuscular drive or efferent motor command inhibiting neural output to the muscle due to a rising  $T_c$ . As such, the purpose of the present study was to investigate the relationship between elevated  $T_c$ , neuromuscular drive and fatigue.

Thirteen subjects (4 females, 9 males,  $22 \pm 1$  yrs,  $73 \pm 2$  kg,  $53 \pm 3$  ml.kg<sup>-1</sup>.min<sup>-1</sup>) performed a series of maximal volatile and evoked contractions of the knee extensors and arm flexors prior to and immediately following cycling exercise to exhaustion in hot humid conditions ( $39.3 \pm 0.8$  degC,  $60 \pm 0.8\%$  rh). Twitch characteristics were assessed using paired electrodes positioned over the femoral nerve on the medio-anterior aspect of the upper thigh and for the biceps brachii over the motor point of the muscle. A supramaximal stimulus was applied using a single square-wave pulse at 50Hz (width 200micro.s, 400V, 1500 - 8000 mA). Central activation ratio (CAR) was calculated as the percentage of peak isometric force obtained during the superimposed contraction resulting from voluntary muscle recruitment. All data was sampled at 2500Hz.

Exercise induced a  $\sim 1.7$  degC increase in  $T_c$  with an end exercise value of  $38.8 \pm 0.1$  degC. The terminal HR was  $192 \pm 3$  beats.min<sup>-1</sup>. No changes were observed between pre and post-exercise values for arm and leg maximal twitch force, time to peak force and half relaxation time. Significant differences pre and post exercise were only observed in CAR for the leg extensors decreasing from 94% before to 91% following exercise ( $P = 0.02$ ) with no change in CAR for arm flexors ( $P = 0.97$ ).

The main finding of this study was a reduced CAR following exercise induced hyperthermia in the involved (leg) but not in the uninvolved (arm) muscle group. This suggests that exercise produces a localised decline in active force by specific muscle groups, implying the central nervous system is able to distinguish which areas are likely to be affected by the  $T_c$  or previous muscle activation and subsequently selectively reduce neural drive. The lack of change in twitch force observed in both muscle groups support the view that force loss may not be due to an inhibition in the peripheral neuromuscular system, but rather, caused by a central discriminatory impairment to this system supporting the view that metabolic and substrate availability are not primary factors in this type of fatigue.

## O112B-5

**Bimodal recovery from exhaustive stretch-shortening cycle exercise**

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**Keywords:** fatigue, stretch-shortening cycle, reflex

Recovery from exhaustive eccentric exercise is reportedly bimodal. This bimodality is observable also for the stretch reflex after stretch-shortening exercises. These changes in stretch reflex as well as in H reflex are likely to be coupled with similar changes in mechanical response. One of the mechanisms suggested for this bimodality is the contribution of the group III and IV muscle afferents whose activation causes reduction of the inputs from Ia afferent fibers. The present study was designed to explore more thoroughly these events responsible for activation of III and IV muscle afferent fibers.

12 healthy males performed very exhaustive stretch shortening cycle leg exercise on a sledge apparatus known to result in muscle soreness and bimodal recovery. The measurement included passive H and stretch reflexes before, immediately after, and periodically until 8 days post exercise. A collection of blood samples including several markers of muscle damage and inflammation were also followed during the entire period.

The results showed an expected bimodal response in H and stretch reflex patterns. During the exercise lactic acid (LA) increased up to 8,2 mM and recovered quickly. Leucocytes, on the other hand, increased with a peak 2 hours post exercise and had recovered on day 8 post exercise. CK continued to increase until day 2 post exercise and had recovered on day 8 post exercise.

It seems reasonable to conclude that the immediate post exercise drop of H and stretch reflexes is due to activation of group III and IV afferent fibres by high LA concentration in combination with probable increase in potassium outflow. Both of these parameters recover quickly and explain part of the quick recovery 2 hours post exercise with concomitant reduction of III and IV afferent activation. The events following the 2 hours post exercise point are very likely to be related to muscle damage and associated inflammation. Group III and IV afferent fibres are probably reactivated during the recovery period after 2 hours post exercise by mechanical factors such as muscle pressure.

#### O112B-6

### The effect of an active recovery on muscle metabolism and team-sport specific repeated-sprint ability

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**Keywords:** lactate, phosphocreatine resynthesis, intermittent exercise

Through time-motion analysis of international field-hockey competition, we have reported that a repeated-sprint protocol involving 6 x 4-s sprints, with ~ 20 s active recovery between sprints represents an intense protocol for assessing RSA in elite field-hockey players. An active recovery has been shown to promote faster clearance of blood lactate and improve power output recovery during subsequent longer duration sprint bouts. The purpose of this study was to investigate the effect of an active versus a passive recovery on muscle metabolism and performance during a more team-sport specific test of RSA.

Nine moderately-trained males (Mean  $\pm$  SD  $\text{VO}_{2\text{max}}$  = 55.1  $\pm$  6.8 mL/kg/min) performed a graded exercise test to determine  $\text{VO}_{2\text{max}}$  and lactate threshold, followed by four RSA cycle tests (6 x 4-s sprints, every 25 s), completed in a randomised order. Two RSA tests were performed with an active recovery (AR; cycling at 60 W, ~30%  $\text{VO}_{2\text{max}}$ ) and two with a passive recovery (PR). Needle biopsy samples were taken from the vastus lateralis muscle pre-test, immediately post-test and post-21 s of recovery to determine muscle lactate ([La-]) and phosphocreatine ([PCr]) concentration.

Compared to PR, AR resulted in a greater power decrement ( $5.6 \pm 1.8$  v  $7.4 \pm 2.2$  %,  $P = 0.005$ ) and lower peak power for the sixth sprint ( $15.3 \pm 1.5$  v  $14.9 \pm 1.5$  W/kg,  $P = 0.02$ ; Fig. 1) during the RSA test. There was, however, no significant difference in work decrement ( $P = 0.1$ ) or relative total work (J/kg;  $P = 0.6$ ) between the two trials. The percent of resting [PCr] was non-significantly lower immediately post-test ( $32.6 \pm 10.6$  v  $45.3 \pm 18.6$ %;  $P = 0.06$ ; effect size (ES) = 0.8) and post-21 s of recovery ( $54.6 \pm 9.6$  v  $71.7 \pm 14.1$ %;  $P = 0.06$ ; ES = 1.2) during AR compared to PR. Muscle [La-] was higher immediately post-test during AR compared to PR ( $71.7 \pm 12.3$  v  $55.2 \pm 15.7$  mmol/kg-dm,  $P = 0.048$ ), whereas there was no difference post-21 s of recovery (55.0

$\pm 11.3$  and  $48.4 \pm 16.7$  mmol/kg dm, respectively;  $P = 0.2$ ). There was a trend towards faster decrease in [La] during AR compared to PR ( $0.79 \pm 0.41$  v  $0.38 \pm 0.44$  mmol/s,  $P = 0.16$ ; ES = 1.0).

The results of this study show that performance during a team-sport specific test of RSA is impaired when an active recovery is completed between sprints. The decrement in performance may be associated with decreased [PCr] resynthesis as a result of increased lactate metabolism during the active recovery trial.

#### O112B-7

### Skeletal muscle growth during the early phase of heavy-resistance training with creatine, protein and carbohydrate supplementation

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**Keywords:** strength training, muscle, creatine

Dietary supplementation is thought to enhance the effect of strength training. Creatine supplementation has been shown to increase performance, body mass, and muscle size, and therefore a possible anabolic effect of creatine supplementation has been discussed. Furthermore, intake of protein supplementation after resistance training may enhance muscle growth. The aim of this study was to investigate the time course of the adaptive changes in muscle size in response to heavy resistance strength training with creatine, protein and carbohydrate supplementation.

36 male subjects (19-27 years) completed 16 weeks of heavy-resistance strength training (3 days/week) with focus on m. quadriceps femoris or participated as controls without training. Subjects were randomly assigned in a double-blind fashion to either a Creatine- (n=10), Protein- (n=10), Carbohydrate- (n=8) supplementation group or a Control group (n=8). Muscle fibre cross sectional area (Type 1 and Type 2 fibre area, Biopsy-samples) were measured at 0, 4, 8 and 16 weeks. Whole muscle cross sectional area (Muscle CSA, MRI) were measured before and after training (0 and 16 weeks).

Type 2 fibre area for the Creatine group increased 17.2%, 20.2% and 23.6% after 4, 8 and 16 weeks, respectively. Increases in Type 2 fibre area were also found for the Protein group after 16 weeks (16.7%), and for the Carbohydrate group after 4 weeks (11.6%). Type 1 fibre area increased for the Creatine group after 16 weeks (10.5%), and for the Carbohydrate group after 4 weeks (11.4%). Muscle CSA increased in all supplementation groups; 7.1%, 3.7% and 6.3% for the Creatine-, Protein- and Carbohydrate group, respectively. No changes were observed in the Control group.

Creatine supplementation seems to augment the growth of type 2 muscle fibres in the early phase and throughout 16 weeks of heavy-resistance training. The increases in muscle fibre areas corresponds with an increase in total muscle creatine concentration for the creatine group after 4 and 8 weeks. However, after 16 weeks of training and creatine supplementation total creatine content was back at pre-training levels whereas type 1 and type 2 fibre areas remained significantly larger than pre-training levels.

## Oral Session

## Molecular Biology 2

O112C

## O112C-1

**Endurance training may reduce diabetes-related impairment in gene expression of vascular endothelial growth factor (VEGF) and VEGF-B in skeletal muscle**

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*Keywords: endurance training, diabetes, vascular endothelial growth factors*

Diabetes is a major risk factor for peripheral vascular diseases. Recent studies have demonstrated that diabetes impairs new blood vessel formation in ischemic tissues, and the impairment in angiogenesis results from reduced expression of vascular endothelial growth factor (VEGF), the main angiogenic growth factor (Rivard et al. 1999). This study was conducted to investigate the effects of endurance training on skeletal muscle VEGF and VEGF-B expression and angiogenesis in diabetic mice.

Diabetic and healthy control mice were divided into training and sedentary groups (n=5/each group). Training groups completed a five-week endurance training protocol on a treadmill (1h/d, 5d/wk). Animals were sacrificed 24 hours after the last training session. Total RNA was isolated from the left calf (SOL+GA+PL) and pooled within each group. Gene expression was analysed with Affymetrix GeneChip (MG\_U74A V2) and further processed with Microarray Suite and GeneSpring softwares. Wilcoxon's Signed Rank test is used to derive biologically meaningful results from the raw probe cell intensities on expression arrays.

Present results show that diabetes decreases ( $p<0.001$ ) VEGF and VEGF-B expression compared to healthy skeletal muscle in both trained and sedentary groups. Training increased significantly ( $p<0.001$ ) the expression of both genes after the five-week training period in diabetic but not in healthy mice.

Endurance training seems to have favourable effects on the expression of VEGF and VEGF-B in skeletal muscles of diabetic mice. In healthy mice, the expression of these genes in trained mice was similar to the controls, which is in agreement with earlier findings. Endurance exercise upregulates VEGF expression in healthy skeletal muscle at first, but the response is attenuated when the training is continued. However, our results show that in diabetic muscle where the basal expression is reduced, the expression of VEGF and VEGF-B is still upregulated after five-week training period. With pooled samples the individual variability is lost, thus the results will be further confirmed with RT-PCR. VEGF is the major angiogenic growth factor, while VEGF-B is important in maintaining the integrity of the newly formed capillaries. These results suggest, that regular endurance training has positive effects on blood vessel growth factors in diabetic skeletal muscle, and it may reduce the risk for peripheral vascular diseases.

Rivard et al. (1999) *Am J Pathol* 154: 355-363

## O112C-2

**Differentiated mRNA expression of myostatin, hexokinase II and HAD in the rat gastrocnemius muscle in response to brief endurance training**

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*Keywords: endurance training*

The discovery of new growth factors involved in the regulation of muscle development provides new starting points to understand the mechanisms involved in the adaptation of skeletal muscle to physical activity. One of these growth factors is myostatin (MSTN), which has been characterized as a negative regulator of skeletal muscle growth and inhibitor of myoblast proliferation. Hexokinase II (HK II) phosphorylates glucose and exhibits increased expression in both mRNA and protein level in response to metabolic challenges imposed by exercise. Hydroxyacyl-CoA dehydrogenase (HAD) is a key enzyme in the beta-oxidation of fatty acids. Its enzymatic activity has been reported to increase after dynamic exercise, but there are only scarce data about HAD gene expression under exercise conditions. The purpose of this study was to analyze the MSTN, HK II and HAD mRNA expression in response to brief endurance training.

12-week-old male Wistar rats (n = 10) were divided into a training and a control group. The rats of the training group swam together in a water tank for 2 x 60 min per day, for 5 days. mRNA levels of MSTN, HK II and HAD were determined by quantitative real time RT-PCR analysis in the gastrocnemius muscle.

We found significantly lower mRNA levels of MSTN in the trained animals as compared to the untrained ones. Conversely, a significantly higher mRNA expression of HK II and HAD could be observed in the same muscle of the trained compared to the untrained group.

The observed changes in the muscle transcript levels of HK II and HAD can be considered as an early adaptation of the muscle tissue, increasing the energy supply of the muscle during the augmented metabolic demands of the contractile activity. The reduced MSTN mRNA levels in the trained group demonstrate that regulation of MSTN expression is a relevant mechanism not only during the development of the muscle in the prenatal phase of the life. The modulation of MSTN seems also to be an important molecular mechanism regarding the adaptation of skeletal muscle in response to exercise. This is underlined by former lines of evidence of our institute, where it was demonstrated that chronic wheel running also lowers MSTN mRNA levels in both gastrocnemius and vastus lateralis muscles of endurance exercised animals.

## O112C-3

**Exercise and rhIL-6 infusion increases IL-6 and PPAR $\gamma$  gene expression in human skeletal muscle and adipose tissue**

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**Keywords:** exercise, PPAR $\gamma$ , IL-6

Exercise is known to prevent development of obesity and diabetes type 2. The cytokine, interleukin(IL)-6 is expressed and subsequently released from contracting skeletal muscle and the transcription rate is further elevated when muscle glycogen content is low. Moreover, recent evidence suggests a role of IL-6 in lipid metabolism as infusion of rhIL-6 into healthy human subjects induces lipolysis. Peroxisome proliferator-activated receptors (PPARs) are transcription factors that act as lipid sensors regulating genes involved in lipid metabolism and energy balance, e.g. lipoprotein lipase, fatty acid transporter protein and GLUT-4. The natural ligands for PPARs may be fatty acids and/or lipid metabolites, thereby adjusting the metabolic response to changes in energy availability. PPARs are thought to be therapeutic targets for many common disorders, including obesity, type 2 diabetes and hyperlipidemia. Moreover, PPAR- $\gamma$ , the isoform dominantly expressed in adipose tissue acts as a receptor for the insulin sensitizing TZD-drugs. Given that physical activity enhances insulin sensitivity, improves the lipid profile and accelerates lipolysis.

We hypothesized that the beneficial effects of exercise might be transferred via an IL-6-dependent enhancement of PPAR expression, followed by increased protein levels, which can then act on energy metabolism. Thus, we obtained biopsies from human skeletal muscle and abdominal subcutaneous adipose tissue in relation to either 3-hours of bicycle exercise (n=7), recombinant human (rh) IL-6 infusion (n=6) or saline infusion (n=6).

In muscle, IL-6 mRNA increased immediately after exercise, peaking at this time-point, whereas IL-6 mRNA in fat increased 1.5-hours post exercise. During rhIL-6 infusion, IL-6 mRNA increased 120-fold in muscle tissue demonstrating a positive feedback effect of IL-6. PPAR- $\gamma$  mRNA levels increased in fat tissue in response to both exercise and rhIL-6 infusion. There was a 5-fold increase in the PPAR $\gamma$  mRNA level 1.5 h post exercise, and during rhIL-6 infusion there was a difference between the control group and the rhIL-6 infusion group.

In conclusion, the present data suggest that physical activity can stimulate PPAR $\gamma$  expression in adipose tissue, which may thereby enhance insulin sensitivity and that IL-6 may contribute in mediating this effect.

## O112C-4

**IL-6 gene expression in human adipose tissue in response to exercise - effect of carbohydrate ingestion**

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**Keywords:** gene expression, IL-6, adipose tissue

Plasma IL-6 is markedly increased during exercise, peaking at the end of an exercise bout. IL-6 release has been demonstrated to originate from the working limb, and the regulation of IL-6 is dependent on substrate availability such

as plasma glucose levels and intra-muscular glycogen content. Furthermore, infusion of rhIL-6 into human subjects has demonstrated a lipolytic effect of IL-6. IL-6 thus seems to work as a lipolytic hormone, released from the working skeletal muscle and released to mobilise energy by lipolysis.

In the present study we aimed to investigate whether exercise would increase adipose tissue IL-6 gene expression, in order to enhance local lipolysis, and whether the regulation of IL-6 would be glucose dependent.

Eight healthy, untrained male subjects underwent two experimental trials of 3 hours of bicycling at 60% of Wmax, which differed only by ingestion of either a carbohydrate drink or a sweetened placebo. Fat biopsies were obtained from the abdominal subcutaneous adipose tissue pre exercise, at 3h exercise, and in the recovery period (1½h and 3h), and submitted to real-time PCR. Blood samples were obtained at pre exercise, during exercise (1h, 2h, 3h), and post exercise (1½h, 3h) and analysed for glucose, FFA and plasma IL-6.

IL-6 gene expression was elevated in response to exercise (p<0.05) and remained elevated throughout the recovery period. IL-6 gene expression was significantly higher (p<0.05) in the control trial (6.49, CI 3.57-13.91) compared with the CHO trial (1.98, CI 1.16-3.83) at end of exercise. IL-6 plasma levels increased in response to exercise (p<0.05), as previously demonstrated. At end of exercise, IL-6 plasma levels were significantly higher (p<0.05) in the control trial compared with the CHO trial (26.01±3.73 vs. 15.58±2.42 respectively).

The present study has demonstrated an increase in IL-6 gene expression in adipose tissue in response to exercise, an effect that is significantly blunted by ingestion of carbohydrate. We hypothesise that IL-6 is released from skeletal muscle in response to muscle contractions and low energy status within the muscle, leading to increased IL-6 plasma levels. This increase can eventually lead to increased appearance of FFA and increased IL-6 production in adipose tissue, thus providing a second burst of IL-6 production in peripheral adipose tissue, in order to maintain the lipolytic effect of IL-6 in the recovery period of exercise.

## O112C-5

**Proliferation activity of myoblast culture in cultural media conditioned of rats soleus muscles at recovery after exercise**

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**Keywords:** exercise, muscle, myoblast

Exercise prescription is a practical tool to enhance individual's health and physical activity. The standard principles for the prescription are mode, frequency, intensity and duration of the exercise. The intensity prescriptions are mainly based on the % -levels of the maximal heart rate (HRmax). HRmax can be measured during maximal exercise test. These tests are, however, expensive and not feasible in population studies. The simplest method to predict HRmax is to use the age-dependent equations e.g. 220-age. For individuals, the accuracy of those equations are less than desirable for safe exercise intensity prescriptions. The aim of this study was to introduce and test two methods to predict HRmax.

These methods were a previously known Multiple Regression analysis (MLR) and a new Total Fuzzy Similarity -method (SIM). The study material (156 men (M) and 99 women (W)) was collected from the research databases of the TRCSM. The included subjects were healthy adults, age: 20-60-yrs,

and they had underwent the directly assessed maximal treadmill test and the sub-maximal UKK 2km Walk Test. The data was divided in to two parts (M:80+55, W:55+44). One part was used for training (building the model and optimising the weights) and the other part was used for testing.

For the SIM- and the MLR -models the mean differences ( $\pm$ SD) between the measured and the predicted HRmax were 0.0 ( $\pm$ 8.8) and 0.4 ( $\pm$ 8.3) bpm for the M. The total prediction errors were 8.7 and 8.3 bpm, respectively. The prediction models explained 36% and 42% of the variation in the measured HRmax. The corresponding values for the W were 0.6 ( $\pm$ 8.3) bpm, 2.2 ( $\pm$ 7.5) bpm and 8.2 bpm, 7.7 bpm and 17%, 33%. The linear AGE-models explained 18% and 7% of the variation in the measured HRmax in the M and W. The total errors were 9.9 bpm and 8.7 bpm, respectively.

We have introduced two new methods to predict HRmax from the exercise test results. Both models seem to give a bit better predictions than the traditional age dependent linear models. The new methods may enhance safety of exercise by increasing the accuracy of individual intensity prescriptions.

### O112C-6

#### Glucose rate of disappearance and oxidation during exercise measured using a single [U-<sup>13</sup>C]-glucose tracer

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**Keywords:** running, carbohydrate metabolism, stable isotopes

Glucose taken up by the muscle is phosphorylated and can either be oxidised or stored in the muscle. During moderate intensity exercise the majority of glucose uptake will be used for oxidation. Jeukendrup et al (1999) used simultaneous infusion of two stable isotope glucose tracers during 2 hrs of exercise at 50%VO<sub>2</sub>max to show that 99 $\pm$ 3% of the glucose taken up (Rd glucose) was oxidised. In a case study using a single tracer, Coggan et al.(1991) reported that 93% of all the glucose disappearing from the circulation was oxidised during exercise at 70% VO<sub>2</sub>max. The aim of the present study was to systematically determine the ratio between Rd and rate of oxidation (Rox) of plasma glucose during exercise using a single glucose tracer.

Five male athletes (VO<sub>2</sub>max 65.5 $\pm$ 2.4 ml/kg/min) performed 30min of treadmill running at 58 $\pm$ 2% VO<sub>2</sub>max and 30min at 77 $\pm$ 1% VO<sub>2</sub>max. After collection of resting breath and blood samples, subjects received a <sup>13</sup>C-sodium-bicarbonate and [U-<sup>13</sup>C]-glucose prime followed by a continuous infusion of [U-<sup>13</sup>C]-glucose at a rate of 0.654 $\pm$ 0.079  $\mu$ mol/kg/min. During exercise blood and breath samples were taken and analysis of expired gas was performed at regular intervals. The isotopic enrichment of plasma glucose was measured by gas chromatography mass spectrometry. Breath samples were analysed for <sup>13</sup>C/<sup>12</sup>C by continuous flow isotope ratio mass spectrometry. The Rox, rate of appearance (Ra) and Rd of plasma glucose were calculated during the last 10 minutes of both exercise intensities. At 58% VO<sub>2</sub>max, Rox of plasma glucose was 24.9 $\pm$ 1.2  $\mu$ mol/kg/min and 33.7 $\pm$ 1.2

$\mu$ mol/kg/min at 77% VO<sub>2</sub>max. The Ra of glucose was 29.9 $\pm$ 1.8  $\mu$ mol/kg/min during the first half hour of exercise and 36.0 $\pm$ 1.9  $\mu$ mol/kg/min during the second half hour. The Rd of glucose was almost equal with rates of 29.7 $\pm$ 1.9 and 35.9 $\pm$ 1.9  $\mu$ mol/kg/min for the 58% and 77% VO<sub>2</sub>max runs. At 58% VO<sub>2</sub>max, 85 $\pm$ 4% of the glucose disappearing from the circulation was oxidised, while this percentage increased to 95 $\pm$ 3% at 77% VO<sub>2</sub>max.

Although there is one previous case report in the literature, to the best of our knowledge this is the first study to investigate Rd and Rox of plasma glucose during exercise in more than one subject using a single tracer. The main finding of the present study was that 85% of all glucose disappearing from the circulation was oxidised by the muscle at 58%VO<sub>2</sub>max, while at the higher intensity of 77% VO<sub>2</sub>max, 95% of the glucose taken up by the muscle was oxidised during exercise.

Coggan et al (1991). *Int J Sports Nutr* 1: 279-288

Jeukendrup et al (1999). *J Physiol* 515: 579-589

### O112C-7

#### Aerobic power and the main determinants of blood rheology: Is there a relationship?

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**Keywords:** aerobic power, blood rheology, plasma viscosity, plasma fibrinogen

The effects of exercise and training on the rheological properties of blood have not received much attention. The present study was designed to determine the relationship between aerobic power as assessed by maximal oxygen consumption and the main determinants of whole blood viscosity namely: plasma viscosity, plasma fibrinogen concentration, and haematocrit.

Ninety four normal healthy subjects (11 female, and 83 male) ages 22-30 yr, with varying level of aerobic power participated in the study. Maximal oxygen consumption (VO<sub>2</sub>max) test was determined by an incremental exercise protocol using either cycle ergometer (N=64) or motorised treadmill (N=30). On separate occasions, an average of 3 venous blood samples, with no stasis, were obtained from each subject at rest. Aliquots of whole blood were placed in heparinised microhematocrit capillary tubes for the determination of haematocrit (Hawksley method) in triplicate. Potassium EDTA plasma was assayed for plasma fibrinogen by a thrombin clotting method. Capillary viscometer was used for the measurement of plasma viscosity.

In this population, it was found that VO<sub>2</sub>max was negatively correlated with plasma viscosity ( $r=0.63$ ,  $P<0.05$ ) and plasma fibrinogen concentration ( $r=0.56$ ,  $P<0.05$ ); while haematocrit was not related to VO<sub>2</sub>max ( $r=0.11$ ,  $P>0.05$ ).

Thus, aerobic power as assessed by maximal oxygen consumption appears to be associated with lower plasma viscosity and fibrinogen concentration. The negative relationship between VO<sub>2</sub>max and plasma viscosity and plasma fibrinogen concentration might suggest that blood is more dilute in individuals with high aerobic power.

## Symposium

### Physiology and Biomechanics of Alpine Skiing

S112D

#### S112D-1

##### Physiological profile of the alpine ski racer

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*Keywords: skiing*

Modern day Alpine ski racing consists of four distinct events including: 1.) Downhill (DH) lasting approximately 2-3 min with speeds in excess of 90 km/h; 2.) Super Giant Slalom (SGS), a shorter, turnier downhill course lasting 1-2 min; 3.) Giant Slalom (GS) performed on steeper terrain with more turns usually ranging in time from 60-90 s; and 4.) Slalom (SL) involving very quick turns on steep terrain consisting of two runs lasting 45-60 s per run. Although greater research emphasis has been made to differentiate energy requirements for each event, the demands of alpine racing still occur in a time frame ranging between 45s and 2 min. Traditionally, tests of aerobic capacity and anaerobic power have been used to reflect race potential although no single test or battery of tests appears to accurately predict performance. Only recently have researchers and coaches begun to question whether or not tests of this nature have any predictive capability to alpine ski racing. It appears that the best international Alpine racers do not exhibit a unique blend of physiological parameters characterized by such groups as marathoners or sprint athletes. But, to better understand how to best train for the demands of ski racing, researchers have begun to study these same biochemical changes, cardiorespiratory demands, muscle activation patterns and biomechanical forces in greater depth. Many of these studies have used the new shaped ski design, but resulted in little deviation in the thinking of aerobic and anaerobic contributions to the sport of alpine racing. There is however great interest in the role proprioceptive training plays in success of modern racers. Fundamentally, ski racing requires athletes to maintain their balance while applying appropriate pressure to the skis as they negotiate each turn in the course. Ignoring for the moment, gravity and friction, elements of speed, centrifugal force and terrain changes pose the greatest threats to the maintenance of balance. Since reaction forces can easily exceed multiples of body weight, it becomes imperative to have proper skeletal alignment coupled with considerable leg strength. Several studies have reported a trend that successful racers tend to be more muscular and taller than their competitors; however, once a criterion level of strength is achieved, additional increases in body mass may be detrimental. It appears that along with traditional ideals of good leg strength and sustainable anaerobic power, proprioceptive input for maintaining balance may be the keys for success.

#### S112D-2

##### Eccentric muscle action: Conditions and importance in alpine skiing

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*Keywords: alpine skiing, eccentric contraction, physiology response*

The objective of this presentation is to provide an overview of the physiology of elite alpine skiing with emphasis on eccentric muscle action involvement. In doing so the different features of concentric or shortening, and eccentric or lengthening muscle actions will be described. Knowledge of how the contractile machinery of skeletal muscle operates during shortening and lengthening actions and the consequences of these actions is important in order to understand the physiological adaptations or events that take place during alpine skiing training and competition. Elite alpine skiers exhibit impressive eccentric knee extensor strength even in comparison with other athletes relying on strength and power. This probably reflects an adaptive response to the specific requirements of the sport. Thus, in the super G, giant slalom or slalom, the electromyographic activity of the "weight-supporting" knee extensor muscles, which lengthen during the course of the turn, is maximal or near maximal. The eccentric action involvement in skiing is unique in that high forces are produced at slow joint-angular movements and maintained for rather long periods of time. The specificity of eccentric action involvement in alpine skiing should be appreciated when designing off-snow conditioning programs.

#### S112D-3

##### Physical requirements of competitive alpine skiing and their interactions with technical skills and material in competitive alpine skiing

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*Keywords: alpine skiing, eccentric exercise, muscle*

During competitive alpine skiing, the load on skeletal muscles is very high. Compared to other competitive sports, muscle recruitment pattern during alpine skiing is special and characterized by a preponderance of eccentric over concentric activity. In competitive slalom, within some tenth of a second, athletes must perfectly dose forces of 2 to 4 kN during the active phase of a slalom-turn. Therefore not only the amount of force development but also the quality of force development is an important characteristic of successful elite alpine skiers. Specifically athletes train the anticipation of the force development on snow by varying the conditions and characteristics of the ski-run and the gating respectively. But in the view of the particular requirements of elite alpine skiing the scientific basis, on which training regimes and testing protocols are based, is narrow and not abreast with the recent developments in materials and technique. Besides presenting the anthropometrical and physiological profiles of modern elite alpine skiers, we will discuss results

of a preliminary study in which we investigated the use of our eccentric-trainer on elite alpine skier. With the use of the eccentric-trainer and a new software application, we are able to quantify the quality of eccentric-force development in leg muscles. In our investigation, the dosage of eccentric force development was best in those athletes having the best world rank positioning in slalom. Further all athletes were able to improve dosage of eccentric force development already after the second training bout. From our results it can be inferred that the quality of eccentric force development can be measured by the use of our eccentric-trainer and that this quality can be trained in elite alpine skiers. The eccentric mode of muscle action during alpine skiing requires high power generating leg muscles and coordination for eccentric muscle activity. Eccentric exercise training therefore appears to be a promising approach to improve performance and prevent injury in alpine skiers.

#### S112D-4

### Specific training and imitation exercises in competitive alpine skiing

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Institute of Sport Science, Austria

*Keywords: alpine skiing, imitation exercises*

In elite sport it seems to be generally accepted that the adaptability of the organism rises with a reduction of the number of the factors to which it has to adapt, as we have to assume a relative limitation of adaptability reserves of the organism. Consequently, it is important to direct one's attention to the development of highly specific means of training. The necessity of using highly specific means of training applies chiefly to so-called seasonal sports such as alpine ski racing. Because snow training in summer is very problematic due to organizational and financial reasons, technique - specific strength and power training as well as the imitation and simulation training of ski specific movement patterns are of high importance.

For the development of specific training exercises the principle of kinematic and kinetic correspondence has to be taken into consideration. This principle states that the special exercises must be in harmony with those parameters of movement which characterise the structure of competition technique. A coordinative affinity between training and competition exercises has the advantage that it results in favourable training stimuli in the musculature relevant to the specific movement. It has the further advantage in that the specific neuronal mechanisms are developed, which improve the strength utilizability in concrete execution of movement, as defined by the technique-specific muscle innervation schema.

In close cooperation with the Austrian skiing association we have tried to develop training devices and exercises which follow the principles of specificity and individuality in the training process of top class skiing. As a basis for the development of ski racing specific simulation exercises detailed biomechanical analyses of modern performance techniques were necessary. In the next step training devices were developed which make the performance of skiing specific conditioning exercises possible. Using the same biomechanical methods we were able to prove that these exercises come very close to the kinetic and kinematic

structure of the competition techniques. In alpine skiing the use of Inline skates might offer an imitation training modality with very high movement affinity. Using biomechanical methods (dynamic, kinematics and EMG parameters) we compared the movement patterns of slalom turns performed on skis with those performed on inline skates. The results show in many areas strong affinities, but in detail also fundamental differences.

#### S112D-5

### Current trends in specific testing in competitive Austrian alpine ski racers - from children to elite athletes

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*Keywords: physical fitness, alpine ski racers*

The long record of consistent success in all age groups of Austrian alpine ski racers is due to an optimized training environment. One of many factors is physical preparation. Even school age ski racers must develop appropriate physical fitness and skills in order to cope with the rigors of racing that are placed upon the musculoskeletal system.

It is essential that racers are exposed to physical testing at an early age and at regular intervals. This has been done with Austrian youth racers since 1996. For example, all students at the Skigymnasiums Stams are tested three times annually. In 2000, a cooperative project with the Austrian Ski Federation was begun to develop a battery of physical tests for ski clubs, specially designed for 10-14 year old children. The physical preparation program of the Austrian Ski Federation ski racers has for years included tests in which specially designed test devices and computer programs are utilized.

The testing series in the Skigymnasium Stams has allowed for long term study (1996-2002) of the developmental changes in physical conditioning of school age racers. During 4 years of school, the boys (n = 34) showed in all parameters a highly significant improvement (repeated measures MANOVA). The girls (n=26) had a highly significant increase only in core (erector) strength and a significant improvement only in core (abdominal) strength. When the girls' test scores were expressed relative to bodyweight, or influenced by bodyweight, there were no improvements. The second example is the mean relative power of the male Junior and Europa Cup teams (n = 26) during barbell squat jumps with varying loads (0 – 125% BW).

The development of physical preparedness norms for ski racers at all age levels aids in the detection of possible future performance drop offs, but even of more consequence - assists in injury prevention. Necessary measures can then be undertaken to help the athlete make the gains needed. In high performance sport long term studies in the sport science literature are rare, especially sport specific long term studies and norm data. It should be noted that the 10-18 years age group is very sensitive to training volume and intensity due to physical development changes which are occurring. Therefore it is imperative that training exercises and programs are designed with the physical development and sensitivity of the athletes in mind.



## Oral Session

### Sociology 2: Integration

O112E

O112E-1

#### The use of physical activity in the treatment of patients with alcohol-related problems

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*Keywords: physical activity, alcohol abuse, psychomotor patterns*

Patient with alcohol-related problems (ARP) require specific therapies, frequently reveal psychomotor difficulties and aren't enough fit. Usually alcohol abusers demonstrate signs of alcohol-related organic damages, such damages include muscle weakness, unstable joints and a disturbed conduction of motor nerve stimuli. The low level of fitness in patients with ARP can be considered as both an effect and a cause of alcohol abuse. The aim of this study is to investigate the physical activity patterns of ARP diagnosed patients.

The sample was composed of n=85 patients. The inclusion criteria required the presence of an alcohol abuse or dependence disturbance, according DSM IV criteria. All subjects were diagnosed current and past conditions using SCID-I and SCID-II. Both clinician-administered and self-administered instruments were used for the present study. The clinician instruments were the LOFOPT (Louvain Observation Scale For Objectives in Psychomotor Therapy) scale. The self-rating scale were the Social Adjustment Scale (SAS), in which attention has been focused on the area devoted to leisure activities, and a questionnaire about physical activities. Moreover, background, personal, socio-demographic and occupational information, details of any family history of psychiatric or alcoholic history illness were obtained from patients. In order to the statistical examination of the data, we conducted a sensitivity analysis using the appropriate tools for analysing relations between variables and using the statistical software R.

Only 36.5% of the patients made sport in the last year, 64.7% never made sport in the last 6 months, 12.9% made sport only once a week, 11.7% twice a week and 10.5% three or more times a week. Differences in the median value of the nine LOFOPT variables at the beginning and at the end were analysed: only for three items the median value at the begin was the same at the end, for the other 6 items, the median value at the begin was always smaller than at the end ( $p$ -value < 0.01). Physical activities variables have been analysed in relation with LOFOPT scores, analysing ordinal-level variables and qualitative variables, moreover also all the others variables observed on the sample were included in the analysis. Finally, we found that there is a very strong association between making sport and making sport with friends, and this suggest the importance of using group or team activity in ARP treatment.

O112E-2

#### Integration through sports: A study of the integration of people with special needs in able bodied sports clubs in Austria within the EU-project Thematic Network Project

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*Keywords: adapted physical activity, sport clubs, integration*

The objective of this TNP is to analyse existing structures of education and formation, inter-university structures, European Associations on APA, governmental organisations and structures on the one hand, with the national sports federations, rehabilitation centres, special education schools and the individual with a disability in general, and to set up a network of 'reflection and action' towards educational and social integration of persons with a handicap through Adapted Physical Activity in the different partner countries.

The final outcome of the TNP for Austria can be diversified into the creation and implementation of national groups for implementation and integration strategies that may bring forth solutions to national problems faced, with regard to the integration of disabled persons into society through physical activity.

One of the main topics - integration in able-bodied sports clubs - was investigated by the way of a master thesis to receive an overview whether sports clubs are prepared to offer "sports for everyone", including people with special needs.

A questionnaire was sent to the umbrella organisations ASKÖ, ASVÖ and UNION which were requested to distribute this within their sports clubs. Furthermore, an interview was conducted with the managing directors on their personal opinion on integration opportunities within their umbrella organisation and their sports clubs.

The rate of return of the 150 questionnaires was disappointing, although they exemplify a satisfactory overview of the nationwide situation. The results allow the expectation that there will be too few opportunities created for integration, and our aim is to find strategies to improve the opportunities for people with special needs in small communities because the Austrian Sports Federation for the Disabled will not be able to meet the demands in the near future.

Based on the role model of Norway, which practised total integration by closing the disabled sports federation, our aim is to find the best strategy to achieve an optimised co-operation of able bodied and disabled sports federations to offer "sports for everyone" on all levels - from recreational to professional. The focus should be on the special education perspective for teachers and coaches.

## O112E-3

**The body in the age of consumption and spectatoritis****Volkwein-Caplan Karin**

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*Keywords: body image, modernity, eating disorders*

The rise of the fitness movement and the subsequent elevation of the body are embedded in a series of major socio-cultural changes which date back to the 1950s. In general, a steadily rising standard of living in terms of disposable income and free time provides the basis for the mass participation in leisure activities, tourism and fitness training programs. The commercialization of the youth culture and the growing pop music business, like the flourishing beauty industry, points to something else than just job fitness or health maintenance. Sport helps to compensate for new deficits in the work process that result, for example, from long hours of intellectual work. However, one of the paradoxes of our times seems to be: the less we need the body in terms of strength and endurance at the work place the more people are concerned with their fitness and their bodies. The "heavenly body" (Penz, 1999) becomes a simplifier of one's personality and "symbolic capital" to attract attention in a wide range of forms. First of all, the hyperperfect athletic figure dominates the model scene. Although the current body ideal for females is thin but muscular and that of males to be big and muscular, body disorder problems are on the rise. The problems span from eating disorders to exercise disorders, and they seem to be worse among the athlete population.

The purpose of this paper is to shed some light on the controversial issues associated with a distorted body image, such as eating disorders and exercise addiction - from a historical and socio-philosophical perspective. Women and men are affected differently; however, both genders are battling with the detrimental consequences of disordered eating in the world of sport. And the influences of the media in supporting distorted views of the body image is not be underestimated.

After a thorough investigation of the above mentioned issues, solutions for the future will be discussed. Coaches, teachers, parents, and friends need to be more aware and help to prevent these problems.

## O112E-4

**Sports for disabled as effective instrument for international understanding and peace****Scherney Andrea, Maier Bernhard, Scherney Andrea, Prokop Ludwig, Becker Hartmut**

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*Keywords: ethics, sport for disabled, peace*

For the topic "sport as effective instrument for international understanding and peace" different directions become recognizably in the approach: the historical/political processing of the Olympic idea, the role of sports in the relationship concerning state and sports, the ethics of sport in the conception of the world of the Christian faith and the approach to see sports as a part of culture, namely sports in the cultural social context.

The sports for disabled will be put into the highlight of these questions and attempts and we will see that the shown bounds of the normal sport will be exceeded by the positive and unusual features of the sports for disabled. The sport for

disabled becomes unfortunately underestimated by his ethical meaning end effect!

The impressive photo and action documentation of an excellent initiative of the Council of Europe (1995-2002) about rebuilding of peace and international understanding in Bosnia and Herzegovina with the instrument sports for disabled should be our example. A short line up of the most important points of the evaluation should be a help for similar projects.

The derived results will underline the ethical meaning of sports for disabled: the paralympic idea, the positive experiences like zest and new motivation for life and growing self-confidence, the positive change of the meaning of performance of people with disability in the society, the extended meaning of fairness and so on.

These lead us to the question and conclusion: How can a good and increased cooperation be carried between this interest of powerful "normal-sports" and this in his nature very meaningful "sports for disabled" or "sports for all" which is often ignored in the society, media and in the economy?

According to "Gender Mainstreaming", a "sports for all-Mainstreaming" should be introduced at all levels in sport. All measures and demands should be checked on the effects of sports for people with disabilities. Only these which have a positive influence on sports for disabled should be supported financially and economically and should be promoted by the media.

## O112E-5

**Thematic Network Adapted Physical Activity (THENAPA) - results of the investigations concerning integration in physical education – European and national perspectives****Dinold Maria**

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*Keywords: children, adapted physical activity, handicapped, integration*

It is the aim of Thematic Network Projects (TNP) to define and to develop a European dimension within the given field of work in co-operation between university faculties and existing academic or professional associations. The Thematic Network Adapted Physical Activity - Educational and Social Integration of Persons with a Handicap through Adapted Physical Activity (THENAPA) promotes co-operation and communication between universities, schools, therapeutic and rehabilitative institutions, sports- and disability sports federations and similar institutions on a national and international (European) level, in order to improve the situation of individuals with special needs by developing adapted programmes for physical education, recreation and sports, by respecting their social integration, and by amelioration of the academic education of the teachers and coaches.

This paper wants to focus on the investigations concerning the situation of integration in physical education (PE) in integrated classes of schools in Austria.

The survey (Marihart 2002) was based on the questionnaire which had been developed and discussed during several forum meetings of the TNP.

The descriptive analysis assessed the adapted facilities for pupils with special needs, the participation rate in PE and some details about the educational background of the teachers involved (like additional training for APA/disability sports or support by other pedagogical or medical personnel, etc.).

It was revealed that a predominant portion of the pupils with special needs did participate in physical education regularly and that only about a fifth of the PE teachers had received special courses or education for disability sports or had relevant experiences.

The discussion of the results focusses on the national perspective. It must be admitted that the investigation did reveal ambivalent aspects. Without going into details (concerning participation in PE, alternative opportunities, equipment and facilities as well as looking at education in adapted physical education of the PE teachers) there has been much variation depending on the school's location in the nine different federal states of Austria. This confirms (among other evidence) that the local administration of inclusive education does not support equal opportunities for everyone.

*Marihart, I. (2002). Integration von SchülerInnen mit Behinderung im Unterrichtsfach Leibesübungen. Unveröffentlichte Diplomarbeit, Universität Wien*

#### O112E-6

### A common European curriculum of adapted physical activity

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*Keywords: curriculum, adapted physical activity, credits*

THENAPA stands for European Thematic Network in Adapted Physical Activity (APA) supported by the European Commission which aims to improve the integration of persons with a disability in the PE lessons at all school levels and in the sportsfederations. It also aims for the improvement and harmonisation of the training of professional experts in APA. The Thematic (APA) Network was started up in 1999 and in the participating countries a representative person was nominated to create an implementation group for the national realisation of the 2 objectives.

Each national group performed inquiries concerning the actual situation of: -integration of pupils with a disability in the PE lessons; -the integration of sportclubs of persons with a disability in the regular sportsfederations; -the situation in each country of the training of experts in APA.

For the objective overview of the training of professional experts in APA the actual situation in each country was made by making an analysis of all training programs at all levels of the basic knowledge in APA.

The conclusion of this European survey was that PE teachers, physiotherapists, recreation therapists and coaches have no sufficient knowledge in APA. Therefore the logical next step was to set up an ACTION PLAN in which APA (general concept) should be compulsory in all training programmes in Physical Education, Rehabilitation, Recreation and Sportperformance in the different levels (ENNSHE). For each level and training program the ideal numbers of credits in APA were determined concerning: APA general concept, Applied human/sport sciences to APA, Applied assessment/evaluation, Applied knowledge on disability, disease, injuries, APA sport techniques, equipment, Research methodology applied to APA, and Work experiences in APA intervention. The content of these

items was defined, which will be very useful in the realisation of the upcoming bachelors-masters structure in the training programs which actually will be implemented the next years in Europe. This basic structure is worked out in CD-ROMS in cooperation with all national keypersons of the Thematic Network.

#### O112E-7

### Reliability and validity of a computer-assisted physical activity questionnaire for 12- to 18-year old boys and girls: a preliminary study

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*Keywords: physical activity, questionnaire, validation*

Specific physical activity measurement techniques are developed to investigate amount of activity and activity patterns. It is well documented that a sedentary lifestyle is an important risk factor for obesity and other health related physical fitness characteristics. In large scale studies, the questionnaire technique is the most popular way to assess daily physical activity. Development of information technology allows implementing a new form of questionnaire administration instead of the paper-pencil administered questionnaire. The aim of this study was to investigate the reliability and validity of a computer-assisted physical activity questionnaire (activities during an usual week) in adolescents.

Thirty-three subjects (10 boys and 23 girls) between 12 and 18 years of age participated in this study. Questionnaire activity indices were calculated and included frequency of moderate and heavy activities, sport participation, transport from and to school and transport during leisure time. Watching TV and computer business were included as measures of inactivity. A test-retest (1 week interval) design was used to estimate reliability. Intra class correlation coefficients were calculated. Validity was assessed by comparing the physical activity recalls with CSA accelerometer counts. CSA accelerometer was worn during one whole week. Pearson correlation coefficients were calculated.

Intra class correlation coefficients varied between 0.64 and 1.00 ( $p < 0.01$ ), with the lowest coefficient for transport during leisure time. Pearson correlation coefficients with mean counts from CSA were significant for all activity measures ( $r$  ranged from 0.51 to 0.72,  $p < 0.01$ ), except for all transport indices ( $r$  ranged from 0.02 to 0.09, ns). The inactivity index (TV and computer) showed no significant relationship with the mean CSA counts ( $r = -0.07$ ).

The results indicate that this computer-assisted questionnaire about an usual week can be considered as reliable. All activity indices showed acceptable validity against CSA, except transport variables. Alteration in the transport questions and in the calculation of the transport indices is recommended. Nevertheless, computer-assisted questionnaires have a place in the survey process. The instrument can be standardised easily and can be directed through specific pathways in order to skip unnecessary questions and to include immediately error corrections.

## Symposium

### Sport Psychology:

### Research and Application to Elite Sport-an Area of Conflict?

S112F

S112F-1

#### Sport psychology: research and application to elite sport - an area of conflict?

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*Keywords: hip joint, applied sport psychology, theory and practice*

This paper is not presenting a single study on a certain object; it is the introduction to a symposium with the same title. Therefore, its aim is to raise questions more than to give answers. The field of the discussion may be characterized by the following polarization: On the one hand, research in Sport Psychology has led to a lot of important results. For example, the effects of relaxation, goal setting, self-talk, imagery, etc. are well explored. On the other hand, all over the world applied sport psychology has developed significantly. Evaluation in this field is subject to a law of professionalism (see Anderson, et al 2002). Nevertheless, evaluation remains underdeveloped. And the connection between the two fields of research and application sometimes seems unsatisfying. The considerations of the presentation are based on an action theoretical approach, heuristic and empirical methods using experimental data, field data and qualitative information.

Results of research provide guidelines for interventions. Of course they can't replace the individual decision-making process of a sport psychologist in the field. The effectiveness of his or her work is based on at least the following parameters: A helpful and clear contract, clarification of the system and its borders, as well as important influences of the environment, positive human contact and mutual esteem; appropriate interventions considering the situation, etc.

Based on these assumptions, applied sport psychology and sport psychological training is much more than the application of scientifically proved methods. Seen the other way round, there may be lots of information in the professional work of applied sport psychologists that is presently not used towards increasing scientific knowledge. Maybe sport psychological research should not feel limited by the traditional sport psychological publication outlets (Culver, Gilbert & Trudel, 2003, p. 12) but develop new methods including qualitative and quantitative data to bring new impulses to the field.

It seems to be time to initiate efforts in combining theory and practice in new and creative ways, although there may be some danger in not being aware of the lack of theoretical and empirical foundation of knowledge. But thinking in a multifunctional systemic and action orientated approach may lead to new perspectives in sport psychological research and application.

S112F-2

#### Sport psychology and professional boxing: From theory to practice

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*Keywords: physical fitness, boxing, physical education, applied science, active lifestyle*

The present paper describes work conducted in professional boxing over a two-year period which included preparation of a boxer for two World Championship contests and a non-title fight. It is based on consultancy work and serves to illustrate issues related to bridging the gap between theory and practice. Two issues are highlighted: 1) the relevance of sport science theory and research in professional boxing, 2) the effectiveness of the sport psychology support programme.

The participant was a professional boxer, aged 29. He had previously fought for a World Title fight some. Despite a generally accepted notion that psychology is important to performance, very few boxers use professional sport psychologists. Many people in the support team claim this role, with the type of advice given varying in quality. It is impossible to separate the boxer from his support team and so a key part of early discussions were to develop trust and for the boxer to value information given by the sport psychologist above information from others.

Discussions were held between the boxer to demystify the role of sport psychology. A Needs analysis was conducted using observational techniques with sparring sessions being videotaped. The boxer, coach and sport psychologist viewed videotaped sessions with goal setting stemming from differences between observed and ideal states, and imagery being used to enact this performance symbolically. Performance profiling was used to identify constructs associated with perfect performance. Mood profiling was used to monitor training adaptation and identify ideal performance states. Rigorous analysis of the opponent's previous performance was conducted, leading to developing specific fight plans.

The boxer adhered to the mental skills training package and participated in video-performance analysis. Psychological data indicated improvements in key constructs of performance. Mood monitoring provided useful insight into the extent to which the boxer coped with training volume. The boxer won all three contests, winning and defending the World Title. Despite gaining credibility with the boxer and coach, having a sport psychologist within the support team was treated cautiously by other boxers, promoters and coaches. It is clear that sport science research has led to identification of factors that influence performance; there is clearly a gap that needs to be bridged between theory and practice.

## S112F-3

**Research and applied issues when working with elite athletes****Robazza Claudio**

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*Keywords: IZOF, research issues, research applications*

A proliferation of field-based research has provided evidence on the effectiveness of different psychological treatments to improve competitive performance. However, investigation focussing on applications has been mainly addressed to show treatment effects without being grounded in sound, theory-driven conceptualisations. For individualised interventions a valuable approach is the Individual Zones of Optimal Functioning (IZOF) model; it aims at describing, predicting, explaining, and controlling subjective optimal and dysfunctional experiences related to individually successful or poor performances.

The IZOF model assumptions have been supported in studies on anxiety and emotions. The majority of studies, however, were addressed to theoretical implications from which to derive applied indications. It is apparent that well-controlled field studies are often problematic to conduct especially when elite athletes are involved. Difficulties are due to time constraints, resistance or hesitancy of athletes and coaches taking part in investigations, and troubles in controlling environmental disturbing variables. Athletes' involvement is most likely obtained with intervention studies specifically addressed to performance enhancement. Alternative to intervention studies, participation can be sought by implementing investigations with a clear focus on applied implications. Some studies aimed at testing theoretical assumptions of the IZOF model revealed "secondary" findings. The beneficial effects upon performance were spontaneously acknowledged by several athletes.

As a consequence of the positive experience, some participants asked for psychological intervention. Researchers should plan their studies keeping in mind research issues and applied purposes as well. They also should emphasise practical implications when working with athletes and coaches.

## S112F-4

**Sport Psychology- a crucial component in high-performance sport****Eberspächer Hans, Immenroth Marc, Mayer Jan**

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*Keywords: sport psychology, mental rehearsal*

When athletes do not reach the goals they have set themselves for important competitions this can often be put down to the psychological deficiency of using the acquired training condition at the desired moment, i.e. the competition. Since one of the main goals of sportpsychological preparation for competition is achieving peak performance just in time, sportpsychological intervention seems especially indicated. Sportpsychology in high-performance sport serves the development and optimization of high performance in sport. In order to reach these aims, the sportpsychologist has a wide range of professional methods at his disposal. Apart from psychological competence in applying these methods, basic knowledge of the specific kind of sport is of utmost importance. Moreover it is necessary that the relevance of the use of sportpsychological knowledge is also recognized by the coaches.

In order to find out about the attitudes coaches have to the efficiency of interventions and to Sportpsychology in general, the demand for professional sportpsychological advice has been examined in a survey among german national coaches (Eberspächer, Immenroth, Mayer, 2002). Three kinds of information were of interest: knowledge and information about Sportpsychology, attitudes to Sportpsychology and its appliance.

The results show that the coaches are -on average- quite well informed about sportpsychological work and have a very positive attitude. Concerning the appliance of sportpsychological advice though, the coaches seem to lack information regarding availability and financing. Main focuses of sportpsychological interventions are the phenomenon of the "world champions of training", i.e. that the athlete cannot repeat the success he had in training at a competition, dealing with injury, motivational problems such as burn-out, emotional problems such as fear of failure and social problems with coaches or the team, for example.

Sportpsychological forms of training and interventions are regulation of self-talk, regulation of activation, training of mental stability in competition and mental rehearsal, which can be defined as "the systematically repeated imagination of an action without its simultaneous practical execution" (Eberspächer, 2001).

*Eberspächer H et al (2002). Leistungssport 32(5), 5-10**Eberspächer H (2001). Mentales Training***Symposium****Vibrations in Sport and Exercise****S112G**

## S112G-1

**Tuning in to soft-tissue resonance****Wakeling James**

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*Keywords: muscle, vibration, resonance*

At heel-strike during walking and running we experience an impact shock which should be expected to cause vibrations in the soft-tissues in the lower extremity. However, observations show that such vibrations are typically small

and of short duration. It has previously been proposed that the body has a strategy of minimizing such vibrations, and in particular the body may use muscle activity to damp excessive soft-tissue resonance (Nigg et al 1995).

Recently, our laboratory has investigated such phenomena. We have demonstrated that the mechanical vibration properties of the soft-tissues, namely the natural frequency and damping coefficient, change with altered muscle force, joint angle and angular velocity during isometric and isotonic contractions (Wakeling, Nigg 2001). When subjects stood on a vibration platform which delivered measured vibration input

then the biggest adaptation of the muscles occur at soft-tissue resonance when the input frequency matched the natural frequency of the tissue (Wakeling et al 2002). In such a situation the muscle activity increased and resulted in increased damping which minimized the soft-tissue vibrations.

Recent experiments investigated the effect of shoe materials on soft-tissue vibrations and muscle activity during walking and provided evidence that supported the concept that the vibration damping is greatest near tissue resonance, and that this concurs with elevated muscle activity. These results have important implications for the use of sports shoes for altering lower extremity muscle activity for both training and competition.

The vibration platform experiments (Wakeling et al 2002) revealed a more far-reaching result concerning muscle adaptation to whole body vibrations with the greatest vibration damping response occurring when the input frequency matched the resonance frequency of the tissue. Thus, during both therapeutic and training situations the choice of the applied vibration frequency relative to the natural frequency of the tissue in question is a key factor in determining the muscular response. Proposed mechanisms for the muscle damping of the vibrations will be discussed in the context of using this for specific training responses.

Nigg BM et al (1995). *J. Appl. Biomech.* 11, 407-432

Wakeling JM, Nigg BM (2001). *J. Appl. Physiol.* 90, 412-420

Wakeling JM, Nigg BM (2001). *J. Biomech.* 34, 539-543

Wakeling JM et al (2002). *J. Appl. Physiol.* 93, 1093-1103

## S112G-2

### In vivo transmission of impact induced bone vibration through the knee joint

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**Keywords:** bone, vibration, running

The ground reaction force (GRF) acting on the foot during heel toe running is commonly accounted as the input signal for shock waves traveling up the skeletal system. Bio-negative and bio-positive effects are often implicated to vibrations caused external by impact forces (Whittle 1999; Lafortune 1995). However, little is known concerning the mechanism of shock transmission along the skeleton. Due to artefacts caused by soft tissue movements the use of skin mounted accelerometers is not a promising approach in this perspective. Therefore the purpose of this study was to quantify the transmission of vibrations from the proximal aspect of the tibia via the knee joint to the distal aspect of the femur in vivo.

Four male volunteers participated in this study (age: 18-40 years, mass: 77-89kg). To avoid skin movement artefacts one intracortical Hoffman bone pin (diameter 3.0mm, length, 60mm) was inserted with the complete thread into the lateral condyle of the right tibia under local anaesthetic. A second pin was inserted into the lateral condyle of the femur. A miniature piezoresistive accelerometer (Kistler piezotron, 8694M1; mass: 2.5g) and a marker array for kinematic analysis was attached on each pin. The subjects ran with a self selected speed ( $2.8\text{m/s} \pm 0.3$ ) under three different shoe conditions. Three valid trials of each subject under each condition were examined. As the natural frequency of the instrumented bone pin was over 120Hz (experimentally determined) the acceleration data was filtered by means of an FFT bandpass (1Hz - 100Hz). Using the vertical GRF (Kistler forceplatform) as trigger (10 N threshold) 100 ms after heel contact were analysed. To assess the shock

transmission the ratio (acc\_ratio) of the peak acceleration at the femur (acc\_fem) in percentage of the peak acceleration at the tibia (acc\_tib) was calculated for each trial. In addition to the acceleration measurements EMG data were taken by surface electromyography from the knee flexor (M biceps femoris) and extensor muscles (M vastus lateralis, M rectus femoris). The sampling rate of all analog data was 2500Hz. An ANOVA was calculated to identify inter-individual differences between the observed parameters as well as to exclude the influence of the different shoe conditions.

On a 5% level the ANOVA revealed no significant differences between the shoes in acc\_ratio, a\_fem and acc\_tib. When all subjects were analyzed together, a relationship appeared to exist between acc\_tib and acc\_fem. A more detailed analysis, however, shows individual differences. Looking at the transmission from the tibia to the femur it appears that for subjects S2 and S3 higher values of acc\_tib lead to higher values of a\_fem. This is not true for subjects S1 and S4. The acceleration data clearly point up differences regarding the shock transmission patterns between the subjects. For subject S2 tibia and femur accelerations show a good congruence within the first 100 ms. In subject S1 the femur data demonstrate a different pattern concerning the magnitude of acc\_fem. The ANOVA (post hoc test) for acc\_ratio revealed significant differences and identified three groups of subjects (G1: S1, S2; G2: S3; G3: S4) (Fig. 1).

These inter-individual differences could be caused by different orientation of body segments (thigh and shank) or muscle activity. The EMG data of the knee flexor and extensor muscles allow a first interpretation of the impact of muscle force to joint coupling and shock transmission potential. Material properties of the cartilaginous tissues of the related joints or morphological differences of these tissues could also influence the transmission of shocks and vibrations along the skeletal system.

Whittle, M.W. 1999. *Gait Posture* 10; 264-275, Lafortune M 1995. *J Biomechanics* 1, 113-117

## S112G-3

### The effects of vibration as an exercise intervention: Current perspectives and future trends for research

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**Keywords:** muscle strength, neuromuscular adaptation, vibration exercise

Vibration is a mechanical stimulus characterized by an oscillatory motion. Recent evidence has shown that low amplitude, low frequency mechanical stimulation of the human body is a safe and effective way to improve neuromuscular performance. Increases in muscular strength and power in humans exercising with specially designed exercise equipment have been recently reported. The effects of whole body vibrations have been studied with subjects exercising on specially designed vibrating plates producing sinusoidal vibrations. Vibration has been also applied locally by means of vibrating cables and/or specially designed vibrating dumbbells producing low-frequency vibrations. Due to its mechanical characteristics, the vibration stimulus produces fast and short changes in length of the muscle-tendon complex. This perturbation is detected by sensory receptors that modulate muscle stiffness through reflex muscular activation in order to damp the vibratory waves. Thus, the excitatory inflow following vibration stimulation is mainly related to the reflex activation of the alpha-motoneuron. Mechanoreceptors are also contributing to the

modulation of muscle activity necessary to damp the vibratory waves. Finally, central activation has also been shown to be affected by vibration. In light of the above observations it seems likely that vibration exercise is capable of affecting central and spinal pathways controlling force generating capacity in skeletal muscle.

A recent pilot study in our lab aimed to understand the acute responses to different vibration stimuli has shown different acute responses with 20Hz and 40Hz whole body vibration frequencies in a population of untrained individuals. In particular, the low frequency stimulus has been shown to acutely enhance vertical jumping ability and hamstrings flexibility as compared to the 40Hz frequency which caused a temporary reduction in vertical jumping ability and hamstrings flexibility. The individual responses to different vibration frequencies were also shown in another study in which a specific frequency was eliciting the highest EMG activity in vastus lateralis muscle.

The preliminary findings on the effectiveness of vibration as an exercise intervention suggest that this novel form of exercise is very promising. However, there is a scope for studying safe and effective exercise protocols for different populations. Safety is one main issue, since prolonged exposure to vibration has been shown to be harmful in humans. More studies are needed in order to determine a safety standard for vibration exercise.

## S112G-4

### Whole body vibration and training

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*Keywords: strength training, vibration training*

In recent years vibration training aroused large interest because some training studies achieved considerable improvements in muscular strength and power(1,4). Despite the positive findings other authors reported no significant additional benefits(3). There is, however, a lack of data

especially concerning the vibration loading and long-term effects. It is hypothesized that repetitive impact forces are the reason for changes in EMG activity and that the effects are subject specific(2). For this purpose a training study with individual vibration frequency was carried out.

48 students participated in the study. The subjects were randomized to two vibration groups and one control. The intervention for both training groups consisted of an 8 week whole body vibration training (3 times a week, 5-7min.d-1) standing on a platform (Galileo, Germany) either in a squatting position (Group A) or carrying out additional exercises (Group B). The individual training frequency was determined by preliminary EMG-activity measurements. Three tests (DJ, CMJ, MVC) were performed initially and after 8 weeks of training. Additionally EMG-data during a drop jump before and after the whole training period were recorded. In general the statistic tests showed no significant results neither within subjects factors, nor between subjects factors in all parameters (CMJ  $p=0.346$ ; DJ  $p=0.197$ ; MVC left  $p=0.341$ ; right  $p=0.981$ , EMG-activities). To take the possibility of individual responses to vibratory stimulus into consideration, the data of each subject were descriptively analysed. We found subjects with not iceable improvement in either one or more parameters and subjects with a decreased performance outcome.

Although the results cannot confirm the considerable gains of other training studies, there is no doubt, that mechanical vibrations represent a great stimulus for the whole body. But there is still very little scientific evidence about the optimal individual vibration load and the effects on different systems of the body. To sum up concerning the vibration training we are far away to give serious training recommendations – there are still more question marks than exclamation marks left.

*Cardinale et al. (2003). Exerc. Sport Sci. Rev., Vol 1*

*Nigg et al. (2001). Ecerc. Sport Sci. Rev., Vol. 29*

*Schlumberger et al. (2001). Sportverletz. Sportschaden. 15(1)*

*Torvinen et al. (2002). Med. Sci. Sports Exerc., Vol 34*

## Symposium

### Overtraining

## S112H

## S112H-1

### Overreaching and overtraining: definitions and indications

**Halsen Shona**

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*Keywords: overtraining, training, overreaching*

When the balance between training stress and recovery is disproportionate, it is thought that overreaching and possibly overtraining may develop. However, the majority of research that has been conducted in this area has investigated overreached and not overtrained athletes. Debate remains open as to the applicability of overreaching data when discussing overtraining and whether these two states can be considered similar in various aspects. There is currently no evidence aside from anecdotal information to suggest that overreaching precedes overtraining and that the symptoms of overtraining are more severe than overreaching. It is indeed possible that the two states show different defining characteristics.

The lack of common and consistent terminology in the study of overreaching and overtraining is another of the many problems associated with research in this area. Terminology previously and currently used interchangeably include: overtraining, overreaching, overload training, unexplained underperformance syndrome, staleness, burnout, overfatigue, short-term overtraining and overtraining syndrome.

Other concerns with research in the area of overreaching and overtraining are the result of a lack of diagnostic tools, variability of results from research investigations, a lack of controlled studies which measure performance, a failure to include baseline and recovery measures and individual responses to training.

The general lack of research in the area in combination with very few well-controlled investigations means that it is very difficult to gain insight into the incidence, markers and possible causes of overtraining. Critical analysis of relevant research suggest that many overreaching and overtraining investigations should be interpreted with caution before recommendations for markers can be proposed. Systematically controlled and monitored studies are needed to determine if overtraining is distinguishable from

overreaching, what the best indicators are of these two states and the underlying mechanisms that cause the fatigue and performance decrements. It is important that future research includes appropriate measures of performance and mood state during normal training, intensified training and recovery periods.

### S112H-2

#### Are there immunological markers for the over training syndrom?

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**Keywords:** exercise, training, immune system

During exercise lymphocytes and neutrophils are mobilised to the blood. In the post-exercise period, the neutrophil number continues to increase, whereas the lymphocyte number declines below pre-values. The increase in neutrophil number is due to that neutrophils lack their ability to invade the host, thus, neutrophilia can be viewed as a sign of immune impairment. The duration of this immune impairment is related to high intensity and long duration of the exercise event. Furthermore, immune changes are more pronounced if the exercise has been performed at low muscle-glycogen level, e.g. if more than one exercise bout is undertaken on the same day with short recovery periods. The mechanisms of actions include cortisol, which is stimulated by muscle-derived IL-6. The latter can be manipulated by carbohydrate feeding during exercise or by anti-oxidant treatment. However, in our opinion, this may be a two-edged sword. Thus, shared mechanisms exist regarding immune impairment and training adaptation.

*Pedersen BK, Hoffman-Goetz L. Physiological Reviews, 80(3): 1055-1081, 2000.*

*Pedersen BK, et al. Muscle-derived interleukin 6 – possible biological effects. Topical Review.*

*J Physiology (London), 536.2. 329-337, 2001*

*Febbraio MA, et al. J Physiol – 2003*

### S112H-3

#### Hormonal and molecular markers of overreaching and overtraining

**Steinacker Jürgen, Lormes Werner, Wang Liangli, Liu Yuefei**

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**Keywords:** overtraining, muscle, hormones

The training response of athletes can be differentiated in the acute response (phase 1), the overreaching response during overload training for up to two weeks (phase 2) and the early overtraining response which allows recovery within weeks and months (phase 3) and the decompensation phase of overtraining (phase 4). These training phases are associated with distinct peripheral-cellular and central-cerebral

processes, hormonal-neuronal regulation and transmission mechanisms.

Peripheral cellular mechanisms in the acute training response (phase 1) are mainly metabolostatic to achieve energy supply and involve associated cytokine and hormonal reactions. The hypothalamus which integrates various error signals (metabolic, hormonal, signals from afferents, and central stimuli) is counter regulating in the acute phase 1 and in overreaching (phase 2). In overtraining (phase 3), central (hypothalamic) mechanisms involve down regulation of pituitary releasing hormones (FSH, TSH, GH) and of the sympathetic autonomic nervous system which contribute to the fatigue in overtraining. The decompensation phase (phase 4) in which ACTH decreases is a serious condition.

### S112H-4

#### Overtraining in athletes: are there clear markers?

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Vrije University of Brussel, Belgium

**Keywords:** overtraining, central nervous system, neuroendocrinology

Overtraining syndrome (OTS) occurs when excessive training load is not compensated with a sufficient amount of recovery for a sustained period of time. OTS is characterized by fatigue and severely reduced performance.

In contrast with our knowledge about the peripheral adaptations to exercise, studies relating exercise to brain neurotransmitter levels are scarce. It is of interest to examine the effect of acute and chronic exercise on neurotransmitter release, since chronic adaptations to training, and disturbances caused by overtraining might be reflected in brain functioning. Physical exercise influences the central dopaminergic, noradrenergic and serotonergic systems.

A number of studies have examined brain noradrenaline (NA), serotonin (5-hydroxytryptamine, or 5-HT) and dopamine (DA) with exercise. Although there are great discrepancies in experimental protocols, the results indicate that there is evidence in favour of changes in synthesis and metabolism of monoamines during exercise. The symptoms associated with overtraining, such as changes in emotional behaviour, prolonged feelings of fatigue, sleep disturbances, and hormonal dysfunctions are indicative of changes in the regulation and coordinative function of the hypothalamus. The hypothalamus is under the control of several "higher" brain centres and several neurotransmitters. It has been suggested that exercise exerts its putative psychological effects via the same neurochemical substrate (the monoamines) as the antidepressant drugs, known to increase the synaptic availability of transmitters. Likewise, study of the neurobiological aspects of exercise may add to a more complete understanding of the aetiology and treatment of overtraining. In several brain nuclei chronic stress will create an adaptation mechanism (autoreceptor mediated, neurotransmitter interactions, or other mechanisms).



## Oral Session

### Physical Education and Pedagogics 2

O112I

#### O112I-1

#### The impact of 40 years of academic discipline development on physical education

**Freeman William, Hyatt Ronald**

Campbell University, United States

*Keywords: physical education, curriculum, history*

Almost 40 years ago Franklin Henry argued the need to develop "the discipline of physical education", a teaching shift from applied methods to the academic, scholarly knowledge needed to support the field in a university setting. While major gains in knowledge were long-term outcomes of the disciplines movement, there is still controversy concerning the ultimate impact on physical education itself.

Where did physical education lose itself? Today no one trains for physical education beyond an undergraduate degree. Graduate education is preparation for conducting research. In sport science much research has little to do with the teaching field. This leads to another concern rarely addressed in the field: A professor cannot gain promotion or tenure in a research university without doing specialized research. Universities in the United States have faced serious criticism of their declining emphasis upon teaching. This results in a field losing its focus regarding its core mission.

For many universities, physical education no longer exists. Teacher education is disappearing from American universities, based upon the idea (shared by many members of the discipline) that it is not sufficiently scholarly to be part of a research university. The new programs are changing their focus to medical concerns that often are unrelated to movement in the sport and exercise setting. They are more likely to do medical research. If teacher education is offered only in the second and third tier of universities (the current trend in the United States), that sends a strong message that education is not a worthy focus of universities. Teaching becomes unimportant. At the same time, the field has been betrayed by its attempt to assume the mantle of "serious science" in the attempts to turn the name of a narrowly-focused subject [kinesiology] into the name of an entire field. This dissociation of scholarship from whole-person physical education and sport must be addressed more seriously, while a profession still exists to deal with the problem. Otherwise, physical education and sport coaching will descend to the realm of "technical training", treated as a remedial and not-very-important concern.

Henry F M (1964). *JOHPER* 35(7): 32-33, 69

#### O112I-2

#### The relationship between motoric and cognitive abilities in early childhood (CHILT-Project)

**Graf Christine, Kretschmann Ellen, Klippel Sonja, Koch Benjamin, Platen Petra, Predel Hans-Georg, Hollmann Wildor, Bjarnason-Wehrens Birna, Dordel Sigrid**

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*Keywords: motor abilities, children, cognitive abilities*

Inactivity in early childhood increases, involving lots of negative physical, psychological and mental consequences. Within the CHILT (= Children's Health InterventionAL Trial) project correlations between motoric and mental abilities were examined.

668 children (51.0% boys; 49.0% girls) were included at the beginning of their first year at school, their height and weight were measured, and their BMI was calculated. Endurance performance of the children was determined based on the 6-min run and the co-ordination based on the KTK (Körperkoordinationstest für Kinder - body coordination test for children). Concentration as a part of mental ability was measured by DLKE (Differentieller Leistungstest für Kinder der Elementarstufe - differential performance test for primary school children).

The children were 6.70±0.42yrs. old, height was 122.72±5.36 cm, weight 24.47±4.59 kg, BMI 16.17±2.27 kg/m<sup>2</sup>. The children worked on 736.17±182.75 symbols and made 11.80±15.37 mistakes. There was a weak positive correlation between MQ and the symbols worked on (r=0.122; p=0.010) and a weak negative correlation with the mistakes made (r=-0.092; p=0.046), respectively. The children whose quantitative and qualitative performance was highly above average in DLKE also showed the better results in KTK (p<0,05). There was no correlation with body weight/BMI and endurance.

There was a positive correlation between coordinative and concentrated activity. This could be explained by combined cerebral learn and controlling processes. The findings underline the importance of physical activity. The increasing problem of inactivity in childhood must be counteracted by early preventive strategies.

#### O112I-3

#### Children's activity levels during physical education lessons in Greek high schools

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*Keywords: health-related physical activity, physical education students, physical activity levels*

Physical education classes can promote children's cardiorespiratory fitness if they are engaged in moderate and vigorous physical activity for at least 50% of lesson time. The purpose of this study was to assess the physical activity levels of high school children during selected physical education lessons.

The physical activity levels of 120 boys and 116 girls, 13 to 15 years old, were assessed over 67 PE lessons in 18 high schools of Prefecture of Attica. The Sport Tester Coded Transmission, Polar Vantage NVTM heart rate telemetry system was used to record the HR of 4 children every 5 seconds during each lesson, and total lesson time was equivalent to the telemeter's total recording time. A univariate ANOVA with 3 fixed factors and activity levels as the dependent variable and post hoc Scheffe tests were applied to identify differences between gender, age groups and selected PE lessons ( $p < .05$ ).

Lessons' mean time length was 33.05 minutes. More than 50% of basketball and fitness lessons' length was spent to HR levels  $\geq 144$  bpm, whereas volleyball lessons' length to HR levels  $\leq 143$  bpm. Gender, age and type of PE lesson were significantly related with children's activity levels ( $p < .001$ ), whereas post hoc tests showed significant differences among all groups ( $p < .001$ ). The activity levels of girls were higher than boys in all age groups and lessons. In basketball and fitness lessons, 14 year old children had higher activity levels, whereas in volleyball lessons, 15 year old children showed increased HR levels compared to the other age groups.

Results suggested that basketball and fitness lessons have a greater potential to promote cardiorespiratory fitness in children. The 14 year old children were found to be more active than 13 and 15 year old children in contradiction with Stratton's (1997) findings about age group differences. Furthermore, in contrast to Stratton's (1997) results, significant differences in physical activity levels were observed between boys and girls. It can be concluded that the examined PE lessons offer the appropriate opportunities for promoting the health-related needs of 13 to 15 year old Greek high school children.

Stratton G (1997). *J. Teach. Phys. Educ.* 16:357-367

#### O112I-4

### Comparison of coordinative skills in two male and female groups

**Aldrian Ulrike**

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*Keywords: motor abilities, motor coordination*

The motivations for this investigation were deficits of coordination subjectively observed in students of physical education.

A group of 10 -12 year old and another group of 17-18 year old pupils were tested on five coordinative skills (reaction, balance, orientation, differentiation, rhythm) and on their coordinative stage of development (testing course). The results of the tests were compared with the help of statistic examination procedures. Both groups were tested with the same testing profile, which all in all consisted of 15 single tests and a testing course. The research covered a period of one semester (WS 2000/2001) and pupils from four different types of Austrian schools participated in the research. The tests were planned in a way that they could be carried out during the PE lessons.

The results didn't show any significant difference between the two groups when the focus was on coordinative combined motions. Significant differences, however, arose in the case of the group of 17/18 year old test subjects, because due to the ontogenetic development they had a better stage of experience in their movements. Enormous differences between boys and girls in both age groups show that the male test persons are more active in their movements.

Possible causes for this stagnant development of movements could be found in the passive behaviour of movements of children, caused by values of society. A solution to the problem of passive movement behaviour of children could be a daily "lesson of movement" and the shining example of adults.

Kleine W (1997). *J Sportunterricht* 11

Meinel K, Schnabel G (1998). *Bewegungslehre – Sportmotorik*

Zimmermann KW (1995). *Geschlechtsspezifische Differenzen in motorischen Fertigkeiten*

#### O112I-5

### Somatic status of boys and girls starting primary school

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Faculty of Natural Sciences, Mathematics and Education, Croatia

*Keywords: somatic status, asymmetry, locomotor system*

It has been generally known that children, starting education at the age of seven, come under growing pressure which results in changes of the locomotory system. Nowadays, children more frequently tend to spend their spare time sitting in front of a computer or a television and less in active playing. The aim of this paper is to establish the state of the somatic indicators of children when starting primary school.

The research was conducted on a sample of 169 girls and boys in the first grade of primary school. The somatic indicators were measured as the from scapula's upper edge to the spine, between highs of scapula's upper, between distance from scapula's lower edge to spine, between highs of scapula's lower, between highs of shoulders, between the distance of nipples, between highs of nipples, pectum excavatum, pectum carinatum.

An essential conclusion is to be brought from these results and that is the existence of a high percentage of locomotory system deformities. Through significance percentage analysis it has been established that the percentage of the thorax deformities is significant at  $p < .003$ . The results also shows that 49.1% of the examined children have deformities in back somatic indicators and 55.1% of the children have these in thorax somatic indicators. These percentages show that there is a great percentage of deformities, so-called paramorfism of the locomotory system in children starting primary school. It has been discovered that there are significant deformities in body posture in children of the both genders starting primary school. These are the children who have not felt more considerable school pressures (spending a lot of time at a classroom desk, carrying heavy school bags...), and already 16.5% out of 32.9% have deformities, i.e. asymmetries of some somatic indicators by 1 cm, and 3.6% out of 19.1% of the children have 2 cm or more. It has also been established that the dominant asymmetrical side of the body is the left one.

In the end, it should be mentioned that we have discovered a permanent presence of asymmetry in locomotory system of children at this age. With this conclusion we urge parents, teachers and all of those who are concerned with the proper growth and development of children to contribute to suppression of this extensive phenomenon which can lead up to multiple psycho-somatic consequences at an older age.

O112I-6

### **Anthropometrical-, physical and motor-, biomechanical- and postural characteristics of elite schoolboys and junior club rugby players with reference to the 2002 season in South Africa**

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Potchefstroom University South Africa, South Africa

*Keywords: rugby, characteristics*

In this study the anthropometrical-, physical and motor-, biomechanical and postural characteristics for elite schoolboys (15-year-olds) and semi-professional junior elite club rugby-players (18 and 20 year olds) were determined with the aim to compare the individual groups. Results of the 2002 season revealed a steady improvement in anthropometrical as well as physical and motor data with increasing age, as can be expected.

Unfortunately, despite this positive tendency, biomechanical and postural results revealed increased values towards unstable core stability and functional dynamics in certain anatomical areas amongst these players. This phenomenon was further strengthened by the high percentage of chronic over-use injuries reported throughout the season. The protocols introduced to address these identified shortcomings will be discussed.

O112I-7

### **Teaching moral standards in sport education?**

**Bockrath Franz**

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*Keywords: ethics, moral education, value differentiation*

Practicing rule-oriented action is a necessary part of any moral development. Young adults, at least, seem to be particularly susceptible to such a form of direct learning. Taking also into consideration that value-relations do not only

play a vital role in games but also in sport competition, i.e. under the aspect of equal opportunities and the intention of winning, there will be no doubt about the fact that sport contributes to moral education - even if so far it has become only partly evident what this contribution actually consists of.

The integration of sport into the regular curriculum of teaching subjects at school points expressively to the educational significance of the subject for the development of the pupil's personality. And, although sport educationalists still lead lengthy discussions about the presumed sense of doing sports at school, thereby stressing either the aspect of sport itself, the teaching of sport or the aspect of the young adult, according to each individual philosophical background, nobody would argue about the statement that the teaching of sport may not be limited to the teaching of physical-related capacities alone.

Consequently, the value-related aspects of sport and sport education are hardly ever doubted, still the question of how to define the precise values that are to be promoted and the corresponding objectives of teaching remains to be controversial and unclear. The task of finding the right answers and even working out recipes for teaching moral education adequately in this discipline is left up to sport education, without having previously agreed upon which educational models would be appropriate to fulfil these self-set standards.

My contribution therefore will focus on three possible concepts of moral education in sport:

- the "Character Education Curriculum" (1)
- the approach of "Values - Clarification" (2)
- the "Theory of Moral Development" (3)

The discourse will analyze these approaches under the aspect of their suitability for promoting moral education in sports, their possibilities and their limits. It will become evident that this sphere of life offers conditions for moral learning which are only insufficiently grasped by universal theories on morale, and that they require their own ways of explanations. Finally, the approach of "Value Differentiation" (4), particularly developed for this purpose, will be presented in its basic traits.

## **Oral Session**

### **Biomechanics 6**

O112J

O112J-1

### **Four weeks of taping can improve sensomotoric control of the ankle in healthy soccer players**

**Langberg H, Knudsen P, Saxkjær J, Friis E, Magnusson P, Aagaard P, Kjær M**

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*Keywords: balance, ankle, tape*

Use of external ankle support for stabilization of injured ligaments as for prophylactic purposes is very common in sports. Despite the extensive use of tape data on the effects of chronic taping on sensomotor control of the ankle is lacking. The aim of the present study was to investigate the effect of ankle taping on the sensomotor control of the ankle in healthy soccer players.

23 healthy young male soccer players with no history of ankle trauma during the previous 6 months participated in the study. 11 subjects (yrs) were in the experimental group and

12 in the control group (yrs). The subjects in the experimental group were taped (two heel-locks, four stirrups, two figure-of-eight) on the dominant foot before each training session and match for 4 weeks. Both, the intervention group and the control group were tested on a force-plate before and after the intervention period. The test for sensomotor control consisted of measurements of movement of center of pressure during one-leg stance (modified Rhomberts test). Each subject was given three trials, and mean of the two best trials were used. The subjects were tested without their ankle taped.

The study showed a significant effect of taping on the sensomotor control of the ankles. The sway length was significantly reduced ( $p = 0.007$ ) for the intervention group. The area of sway and the area of confidence ellipse were also significantly reduced ( $p = 0.022$  and  $p = 0.047$ , respectively). No differences were found in the control group.

In this study we show that taping of healthy ankles of 4 weeks improves the sensomotoric control of the ankle determined as sway length, area of sway and confidence ellipse area. These data is very promising as they point towards a positive effect

on prophylactic taping improving sensomotor control and thus improving postural control, balance and stability over the ankle joint. Based on the data one might suggest that even healthy ankles could be taped during situations with high risk of ankle trauma in order to prophylactically avert ankle distortions.

### O112J-2

#### Exercise induced muscle damage disturbs motor control of rhythmic movement

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University of Jyväskylä, Finland

**Keywords:** *eccentric exercise, muscle damage, motor control*

A long-term decrease of reflex amplitude after repeated eccentric contractions has been suggested to be due to potential intrafusal damage (Avela et al. 1999). Moreover, eccentric actions have been found to disturb position and force matching capability as well as the movement sense (e.g. Brockett et al. 1997). Since sensory peripheral feedback is necessary for fine control of the amplitude and timing of the antagonistic muscles in voluntary movement (Forget & Lamarre 1987), it could be expected that eccentric exercise may disturb the motor control of maximal velocity rhythmic elbow flexion/extension movement (RFE).

Seven male students performed an exercise of 100 maximal eccentric (EE) and 100 maximal concentric (CE) elbow flexions separated by 4 weeks. Movement range was between 170-40° and angular velocity 2 rad (s<sup>-1</sup>). RFE was performed in sitting position with right forearm in horizontal plane with visual feedback. EMG was recorded from BB and TRI. RFE tests and s-CK determinations were conducted before, after, 1/2 h, 2 d and 7 d after the exercises. B-La was taken before, after and 1/2 h post-exercise.

Both maximal eccentric and concentric force was not fully recovered 7 d after EE. However, fatigue did not affect the velocity of RFE and flexion/extension relation in the cycle. Neither the absolute amplitude nor the relative duration of the BB and TRI activity in the cycle changed post-exercise. However, the activity of antagonistic muscles seemed to appear earlier in the cycle up to 7 d after EE in some subjects. The changes in timing were significant for transition from extension to flexion. The s-CK peaked 7 d after EE.

Parallel with observations of the deafferented patients in fast target (Forget & Lamarre 1987) as well as in rhythmic sagittal plane movement (Nicol et al. 1997) present results suggest that sensory feedback could affect the fine control of antagonistic muscles. A long-term modulation of activity pattern in RFE after eccentric exercise may well be caused by the perturbation of mechanoreceptors within muscle-tendon complex. Probably, acute mechanical failure of the elbow flexors and the delayed muscle damage related inflammation processes affected the peripheral reciprocal control of antagonistic muscles in RFE.

Avela et al. (1999). *J Appl. Physiol* 86:1292-1300.

Brockett et al. (1997). *Brain Res* 771:251-8.

Forget and Lamarre (1987). *Human Neurobiol* 6:27-37.

Nicol et al. (1997). 2nd ECSS Congress, Copenhagen, Abstract Book, 796-7.

### O112J-3

#### Neuromuscular changes after maximal explosive muscle contraction

**Tomazin Katja, Jereb Blaz, Ulaga Maja, Strojnik Vojko**  
Faculty of Sport, University of Ljubljana, Slovenia

**Keywords:** *neuromuscular fatigue, explosive muscle contraction*

The aim of the study was to compare muscular responses induced by trains and doublets of different stimulation frequencies.

Ten students (23.5±2.2 years of age, 77.8±4.5 kg, 180.7±3.1 cm) performed 3 sets of maximal explosive knee extensions. Each set had 5 repetitions with a load of 90% of 1RM. Rest between sets was 5 minutes. Measurements were obtained after warm-up, after 1RM, after each set five minutes after the last set. The following measures were obtained: twitch of m. vastus lateralis, response of m. vastus lateralis to double electrical stimulus (100 Hz and 20 Hz) and response to trains of high (100 Hz, 0.8s) and low (20 Hz, 1s) frequency stimulation. The significance of differences between measured parameters pre- and after the 1RM, and after each set were tested with paired sample t - test at 5% alpha error. Single twitch force potentiation after 1st (58.5%±16.8%, P<0.001), 2nd (46.5%±11.8%, P<0.001) and 3rd sets (67.6%±71.3%, P<0.05). Doublets induced by 20 Hz and 100 Hz showed force potentiation after 1st (44.5%±13.3%, P<0.001; 25.2%±12%, P<0.001), 2nd (36.2%±13.4%, P<0.001; 22.7%±8.9%, P<0.001), 3rd sets (30.7%±14.3, P<0.001; 19.7%±9.3%, P<0.001). Force potentiation, induced by trains with 20 Hz and 100 Hz, after sets were not significant.

Although a high frequency fatigue was expected after explosive knee extensions, we observed a single twitch potentiation probably due to better excitation - contraction coupling. Accordingly, doublets induced by 20 Hz and 100 Hz also showed force potentiation, significantly greater in 20 Hz than in 100 Hz. In trains, potentiation after 20 Hz trains was again greater than after 100 Hz train, however, the differences were not significant. Greater Ca<sup>2+</sup> flux per action potential into sarcoplasm and more efficient Ca<sup>2+</sup> uptake back to the SR (Kugelberg and Thornel, 1983) have greater effect on muscle force at single electrical shocks and sub-tetanus stimulation frequencies in trains. For that reason, the force potentiation was greater in single and double electrical shocks at sub-tetanus frequency. The potentiation diminished after the third set. From the 100/20 Hz force index it would be possible to speculate on low frequency fatigue in later sets.

Kugelberg E, Thornel L.E (1983). *Muscle and Nerve*, 6: (149-153).

### O112J-4

#### Impact of sensorimotor-training on the force production capacity of the leg extensor muscles

**Gruber Markus, Gollhofer Albert, Alt Wilfried, Lohrer Heinz, Bruhn Sven**

University of Freiburg, Germany

**Keywords:** *sensomotor training, RFD, neuromuscular adaptation*

The ability to generate high muscular strength within short time periods is of functional importance not only for active stabilisation of joint complexes but also as a basic quality in many sports disciplines. Whereas maximum voluntary strength is largely dependant on the cross sectional area of

the muscle it is well agreed that RFD is basically related to neural activation of recruited motor units (Enoka 1993). The purpose of the present work was to examine the functional adaptations of a special sensorimotor training on (RFD) and strength capability during maximal isometric muscular actions (MVC).

Fifty subjects participated in three studies (S1; S2; S3) with identical experimental setup (S1: twenty sport students age: 24±2; S2: eighteen recreational skiers age: 29±7; S3: twelve recreational skiers age: 64±6). The training program consisted of various postural stabilization tasks. In order to focus primary adaptations to the muscles encompassing the knee joint, all subjects had to wear skiboots throughout the training session. Maximal leg extensions (MVC) were measured before and after the training. EMG signals were recorded from the leg extensor muscles. For statistical analysis paired t-tests on 5% level were calculated.

In all three studies significant increases in maximal RFD (from 18% to 38%) could be shown, whereas sensorimotor training had no impact on maximal strength of the leg extensor muscles (-5% to 5%). For the m. quadriceps mean average EMG increased, although not significantly, for the time interval relevant for RFDmax. Almost no changes could be observed during a comparable time interval at maximal force.

Increase in RFD due to the training regimen is probably caused by increase in segmental excitability. Increase in segmental excitability may comprise supraspinal and spinal adaptations i.e. elevated motoneuron excitability, reduced presynaptic inhibition and/or increased central motor drive. On the basis of reflex adaptations due to sensorimotor-training (Gollhofer 1997; Gruber 2000) it is suggested that for the described training regimen the influence on spinal adaptation mechanisms is bigger than on supraspinal ones.

Enoka R M, Fuglevand A J (1993). *Current Issues in Biomechanics*, 215-235.

Gollhofer A, Scheuffelen C, Lohrer H (1997). *Novartis*, 109-122.

Gruber M, Bruhn S, Gollhofer A (2000). *Proceedings of 5th Annual Congress of the ECSS*, 296

#### O112J-5

### Long term neuromuscular effects of preventive ankle bracing

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**Keywords:** *prevention, neuromuscular control, ankle sprain*

It has been shown that external ankle stabilizers have mechanical as well as neuromuscular effects at the ankle joint. Many authors investigated the preventive effects of external ankle stabilizers and the influence on motor performance in different kinds of sports. However, long term effects of preventive bracing on the neuromuscular system and ankle joint mechanics have not been published yet. The purpose of this study was to investigate the neuromuscular and mechanical effects of continuously ankle bracing over a 4 weeks period.

A total of 10 male volunteers participated in this study (35.8±5.6 years; 76.3 ±7.6kg). Pre and post measurements comprised examinations of maximum isometric and isokinetic eversion strength (MVC) (KinCom 500H) and electromyographic recordings from M. peroneus, M. tibialis, M. gastrocnemius med. and M. soleus. A tilt platform was used to produce an unexpected inversion (30°) and plantar flexion (15°) stress at the ankle joint. The reflex activity of 4

ankle joint muscles was quantified by integrating the rectified and averaged emg-signals (iEMG). All subjects were instructed to wear unilaterally an individually adapted ankle brace (Aircast®) 24h a day. They performed their normal daily activities including work and even leisure sports activities.

Mean of maximum isometric eversion strength (MVC) showed no statistical significant differences between pre experimental and post measurements. EMG activity of the M. peroneus during MVC was not affected. Mean ankle joint inversion amplitude during sudden tilt movement was nearly the same (20.8 ± 9.1°) compared to measurements prior to the bracing period (21.3 ± 5.4°). The EMG recordings of the M. peroneus before and after the experimental period were not found to be affected significantly.

From immobilisation studies one could conclude that the more or less permanent use of braces could cause atrophy to the neuromuscular system or damage to soft tissue (Akeson et al. 1987). After 4 weeks of bracing using an Aircast® Ankle brace no influence on isometric maximum eversion strength was measurable and reflex activity was not affected. It seems unlikely that neuromuscular properties of the muscles stabilizing the ankle joints are affected. The preventive use of ankle stabilizers, however, should always be accompanied by specific sensomotoric stabilization training in order to optimise the neuromuscular system and to ensure the highest protection level for the ankle joint.

#### O112J-6

### Changes of movement patterns and hurdle performance following traditional and differential hurdle training

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University of Leipzig, Germany

**Keywords:** *pattern recognition, differential learning, hurdle sprint*

To improve technical skills in sports it is often recommended to repeat the same movement over and over again. Such learning strategies assume implicitly that generalized prototypes exist and that these prototypes can be achieved by copying many times. Strong indications for the individuality of movement behavior (Schöllhorn 2000) and a low probability for the repetition of two identical movements (Hatze 1986) lead to question these assumptions. Based on the coordination dynamics approach the concept of differential learning tries to utilize the fluctuations in human motor behavior to induce a self organising process to the athlete which takes advantage of individual movement and learning characteristics (Schöllhorn 2000). The purpose of this study was to investigate effects of differential learning on hurdle sprint technique as well as on hurdle performance.

Ten female hurdle sprinters were separated into two groups: Group D performed hurdle training according to differential learning, while group T performed traditional hurdle exercises. For two months, both groups trained hurdles twice a week for 45 min. Pretest and posttest consisted of hurdle sprints over 3 hurdles as well as 30m sprints. Time courses of the main joint angles and angular velocities were analysed using 3D high speed cinematography and compared statistically by means of cluster analysis. A technique index was established.

After two month of hurdle training, the mean hurdle index (HI) decreased for both groups. Higher decreases as well as highest increase of HI were observed in group D. Considering the cinematic variables, hurdle trials were mainly clustered by individuals (recognition rate: 70,9%). For the pretest and

posttest trials of group D rates observed were 86,7% and 46,7%, respectively. Group T showed a contrary tendency (pretest 53.3% / posttest 60.0%). The higher decreases of HI in group D provides evidence for a high effectiveness for the differential training approach. Considering the lower recognition rate for the posttest trials and the decrease of HI for group D, subjects of the differential learning group seem to perform better with less similar movement patterns. Whether this results from a better adaptability to different conditions or describes a transition between stable patterns can not be clarified. Overall, the differential learning approach seems to provide an alternative for effective and motivating training.

Hatze H (1986). *Journal Motor Behavior* 18, 5-16  
Schöllhorn WI (2000). *Acta Academiae Olympique Estonia*, 67-85

O112J-7

### **The motor abilities of basketball players compared to handball players and weightlifters**

Ángyán Lajos, Téczely Tamás, Pálfai András, Karsai István

University of Pécs, Medical School, Hungary

*Keywords: basketball, motor abilities, testing*

The purpose of this study was to examine the ability profile of elite basketball players from three aspects: (1) to test their motor abilities at the end of the preseason-conditioning program, (2) to compare their motor abilities with handball players and weightlifters in order to determine which variables distinguish best between them, and, (3) to describe the changes induced by the competitive season.

A series of measurements were done before the official competitive season, just after finishing the preseason-conditioning program. All measurements were repeated three months later with the basketball players. Anthropometrical measurements, static and dynamic motor tests, as well as sport-specific motor tests were used.

Among the standard body measures, low body fat was found, which showed a positive correlation with running and zigzag dribbling the basketball among traffic cones. The general motor tests indicated fit physical condition for the group as a whole. However, two players' flexibility was little, and another one had problems with balancing. The comparisons of the performances of basketball players with handball players and weightlifters showed significant differences among anthropometrical measures, but only slight variety of the general motor tests occurred. Expectedly, the sport-specific tests distinguished well between the three groups. The measurements during the competitive period verified some improvements in specific motor abilities, but no significant change in body measures and in performance of general motor tests.

It is concluded that (1) the preseason-conditioning program is important to develop both static and dynamic motor abilities. (2) The anthropometrical and the sport-specific test differentiate well between the different groups of athletes. (3) The motor abilities developed by the preseason-conditioning program did not change significantly during the regular competitive training.

## Poster Session

## Training and Testing 4

P11M

## P11M-01

**Winning pacing strategy for 2000m rowing****Garland Stephen**

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**Keywords**

The aim of this study was to find the winning pacing strategy for 2000m rowing. Wilberg and Pratt (1988) obtained cycling race profiles from competitors in world-class competitions in the pursuit and 1km time trial events and compared the performance and race pace profile between top- and bottom-ranked riders. Their results showed that the winning riders used a different strategy from the losing riders.

The present study used a similar method - data from every heavyweight race of the Olympics in 2000 and World Championships in 2001 and 2002, and data from 170 2000m rowing ergometer time trials performed at the 2001 and 2002 British Indoor Rowing Championships were analysed.

Races were only included in the analysis if there was good evidence that the athlete or crew completed the race in the fastest possible time. For example, boats trailing in last place may have deliberately slowed toward the end of the race in order to conserve energy for subsequent races. These boats were excluded from the analysis. This contrasts with the earlier cycling study (Wilberg and Pratt, 1988) which overlooked this possibility. Split times for each 500m of the remaining races were then normalised and averaged to give race-pace profiles.

911 on-water races fitted the inclusion criteria described in the method. Results for both the on-water races and ergometer time trials indicate that rowers performed the first 500m of the race faster than subsequent sectors - the first 500m performed at about 24.4% of the total time, and subsequent sectors 25.2%, 25.3% and 25.1%.

These data indicate that for 2000m rowing, there was a pacing strategy that all athletes or crews adopted when they attempted to complete a race in the fastest possible time - this involved rowing the first 500m at an average pace faster than the rest of the race. This profile was not different for the different types of race considered. The results of this study suggest that competitive rowers should adopt the pacing strategy outlined. However, this study has only shown the self-selected pacing strategy used by rowers, but has not shown the physiologically optimal pacing strategy, nor provided reasoning as to why the first 500m is rowed faster than the other sectors.

Wilberg RB, Pratt J (1988). *Can J Sports Sci* 13: 208-213.

## P11M-02

**Interval sprint and interval endurance capacity in young talented soccer players****Lemmink Koen, Elferink-Gemser Marije, Visscher Chris**

University of Groningen, The Netherlands

**Keywords:** soccer, interval sprint capacity, interval endurance capacity

As a result of the strong interval character and the duration of soccer matches, soccer players need a well-developed ability to perform high-intensity activities like running and sprinting,

as well as the ability to recover properly during low-intensity activities such as walking and jogging over a long period of time. So, interval sprint capacity and interval endurance capacity seem to be important characteristics for young soccer players, a lack of which may limit a soccer player's potential performance level. Goal of this study was to determine the relationship between interval sprint and interval endurance capacity and future performance level of talented youth soccer players.

Seventy-five professional youth male soccer players ( $15.5 \pm 1.54$  years, range 12-17 year) in three age categories (13-14, 15-16 and 17-18 years) participated in the study. Interval sprint capacity and interval endurance capacity were measured using the Repeated Shuttle Sprint Test (RSST) and the Interval Shuttle Run Test (ISRT), respectively. The RSST required the players to perform three 30-m shuttle sprints (2x5m and 2x10m) alternated with short periods of rest. During the ISRT, the players alternately ran 20-m shuttles for 30 s and walked for 15 s. The running speed increased every 90 seconds until exhaustion. The players were categorised as potential top players and potential sub top players based on a judgement of the coaches.

Results indicate that interval sprint capacity (total sprint time) and interval endurance capacity (number of 20-m runs) are related to age, i.e. the higher the age category, the better the performance on both interval tests ( $p < .05$ ). Potential top soccer players possessed better interval sprint and interval endurance capacity compared to potential sub top soccer players ( $p < 0.05$ ).

Interval sprint capacity and interval endurance capacity seem to be important characteristics for professional youth soccer players. These characteristics increase with age and discriminate between top and sub top soccer players. The classification in top and sub top players was based on the judgement of the player's coaches and there is no guarantee that the top players will reach the top at adult age. If using those characteristics as a tool for selecting within a group of young talented soccer players it is important to keep in mind that the development of interval sprint capacity and interval endurance capacity depends on biological changes during childhood.

## P11M-03

**Using the perceived exertion to analyse the differences between external and internal load: an attempt to associate weight indices to training zones in swimming****Rivas A, Martín R, Pampín V, Penas JA, Braña S**

INEF Galicia, Spain

**Keywords:** external workload, training zones, balance of training

One of the most important tasks for the trainer is the possibility of having a balance between the load he want to propose to the athletes and the real effect that this workload has to them. In the software tool called AETN-SPyCE v1.0 (devoted to help in planning, programming and balance procedures in swimming) some indexes are used to identify the intensity of the exercise. So, each training zone has its index that will be used to weight the volume related to this

zone. The aim of this study is to show if these indexes are adequate and, if not, try to propose new indexes for each training zone.

Data from six swimmers were registered. All of them with level between regional and national championships and adult age. Each swimmer had to fill a sheet before and after a training session and mark in a linear scale his general perceived exertion, and also his state for specific items such as muscular fatigue, muscular pain, energy system, nervous system, mental fatigue and motivational state. Also, basal heart rate is registered in the morning to analyse correspondences with variations of external and internal perceived load. Also weight is controlled once a week. All this data has been compared with theoretical external load calculated by AETN-SPyCE v 1.0.

Here are represented data from last season during twenty-seven weeks. Correlations between all swimmers were significant and an average perceived workload was compared with external workload. A similar analysis was done for each swimmer vs. external workload and for each training zone between theoretical and perceived workload in the sessions with this objective.

Some differences were found depending on the level of the swimmer.

We can see that some adaptations over theoretical indexes may be done if we want to adjust theoretical curve to perceived one. This adaptation has to be obtained from individual training zone analysis. From the results we can conclude: Theoretical indexes for aerobic zones are adequate. Indexes for maximum speed zones weight stronger than how the swimmers perceive. Indexes are quite sensitive to volume increases.

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#### P11M-04

### The development and evaluation of a hockey specific shuttle run test as an assessment of aerobic capacity in male field hockey players

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**Keywords:** field hockey, aerobic capacity, shuttle run

The standard 20-metre shuttle run test (20-MST) devised by Léger and Lambert (1982) has been extensively used as a field based test of aerobic capacity. Incremental tests to volitional fatigue involving sport specific manoeuvres have been developed for other sports. The aim of this study was to develop and evaluate a hockey specific shuttle test (HST), and to compare data with the standard 20-MST for the assessment of aerobic capacity in male field hockey players. The modified test carrying a hockey stick, involved an 18m running sequence with a tackle, push and hit incorporated at the end of shuttles 2, 4 and 8 of each level, respectively, shuttle run 6 was replaced by a dribbling action performed with a ball. During testing maximum shuttle score was recorded and heart rate (HR) monitored every 5s using Polar Team system (Polar Ltd., Finland). Players from three groups, advanced (n=14; age=24.9±3.8yrs, mass=75.1±6.1kg; height=176.8±5.4cm), intermediate (n=8; age=28.6±7.9yrs; mass=80.2±9.7kg; height=177.4±8.3cm) and novice (n=15, age=22.2±4.3yrs; mass=76.5±11.2kg; height=179.2±8.2cm), performed the two tests one week apart on astroturf playing fields in random order.

Scores for 20-MST and the HST for the advanced group were 13.65±1.2 and 14.77±1.2 levels, intermediate's were 11.27±1.5 and 12.42±1.3 levels, and novice's were 11.92±1.4 and 12.22±1.5 levels, respectively. HR data at fixed levels (4, 6, 8, 10 and 12) and at maximum were compared across the two tests. Comparison of maximum scores across tests yielded ICC(2,1) > 0.82 with 95% limits of agreement = -0.8 ± 1.5 levels, and using paired student's T tests significantly higher (P<0.05) maximal data were recorded for all, advanced and intermediate groups. No significant differences were observed comparing HR data during 20-MST and HST at levels 4 and 6. However, at level 8 and 10 significantly lower (P< 0.05) data were recorded during HST for the advanced group only (179±11 vs. 175±9 bpm and 186±9 vs. 182±8 bpm, respectively). At level 12 significantly lower HR data were recorded in both advanced and novice groups (191±8 vs. 188±7 bpm, n=14 and 188±8 vs. 185±11 bpm, n=5, respectively). At exhaustion no significant differences in HR data were observed.

The preliminary findings of this study indicate good similarity in test scores between the standard 20-MST and the HST. Further evaluations of intra-test reproducibility and prediction of VO<sub>2</sub>max by a treadmill based graded incremental test are presently being undertaken.

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 Léger LA, Lambert J (1982). *Eur. Jn. of Appl. Physiol*, 49, 1-12

Steininger K, Wodick RE (1987). *Brit. Jn. of Sports Med*, 21(2), 23-26

#### P11M-05

### Physical conditioning status of Croatian top-level female handball players changed by the preparation period training programme

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**Keywords:** handball, preparation period, conditioning status

Success in team sports, handball as well, is determined by a developmental level and structure of a large number of abilities, attributes and the net of technical-tactical knowledge of players. The present study deals with the determination of changes in certain indicators of conditioning status (fitness) of a top-quality female senior handball team.

The sample of participants is comprised of 18 senior female players, members of the RK Podravka, Koprivnica, champions of the Croatian First League. The sample of variables consisted of the 9-item battery of tests measuring physical conditioning status. Experimental procedure is presented by a training programme implemented during the preparatory period of the top-quality female handball team.

The results of multivariate analysis of variance (MANOVA) reveal statistically significant global differences between the first and the second measurement, meaning that in the segment of the overall preparedness defined by the conditioning fitness, significant positive changes occurred, caused by the effects of the adequate training programme implementation during the preparatory period. The results obtained at the global level were confirmed at the level of partial effects of the variables assessing particular functional-motor abilities. The findings allow for a conclusion that the applied training programme considerably influenced the positive changes in functional and motor indicators of fitness (motor-functional preparedness), which is a part of the overall preparedness of top-quality female handball players.



There are statistically significant differences at the global level. The greatest changes occurred in variables assessing repetitive power of the trunk, alactic speed endurance, agility, lactic speed endurance and speed power of a sprint type.

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#### P11M-06

### Metabolic response to strength endurance training in specifically trained and untrained males

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**Keywords:** intensity, strength-endurance training, metabolic response

There is no fixed ratio between intensity (% of 1-RM) and the number of repetitions (cf. Hoeger et al. 1990). A higher number of repetitions is associated with a higher loading duration and the higher loading duration achieves a greater anaerobic glycolysis with lactic accumulation. The aim of this study was to predict the number of repetitions and the lactic acid concentration in three different training groups.

Thirty-nine male subjects (the subjects represented three categories: 13 untrained, 13 elite athletics and 13 elite wrestlers) were tested to determine the maximal number of repetitions at 60 percent of 1-RM in bench press exercise. Totally, all subjects had to perform 6 sets with a one-minute rest interval between the sets. To determine the metabolic strain, the lactic acid concentration in rest and at the end of exercise was measured.

The repetitions at 60 % 1-RM decreased significantly over 6 sets [ $F = 864,77$ ;  $p < 0,001$ ;  $\eta^2 = 98,9$  %]. A significant difference in repetitions at 60 % 1-RM was observed between all three groups [ $F = 5,69$ ;  $p < 0,01$ ;  $\eta^2 = 72,7$  %]. Post hoc single tests indicate a significant difference between untrained and wrestlers [ $p < 0,05$ ] and a significant difference between athletics and wrestlers [ $p < 0,05$ ]. There is no difference between untrained and athletics [ $p = 0,83$ ]. There is no difference in lactic acid concentration in rest between all three groups [ $F = 1,17$ ;  $p = 0,32$ ]. Lactic acid increased significantly during exercise [ $F(5; 175) = 355,21$ ;  $p < 0,001$ ;  $\eta^2 = 99,7$  %]. The increase is 90,3 % from set 1 to set 6. There is no statistic significant difference between groups [ $F(2; 35) = 2,90$ ;  $p = 0,07$ ;  $\eta^2 = 74,3$  %].

The extent of the decrease in the present study was different in the three specific groups. Wrestlers with specific strength endurance training could perform more repetitions at a given intensity than untrained and athletics. Athletics have a higher proportion of FT muscle fibres and can therefore produce more lactate at the same relative exercise intensity than subjects with a lower proportion e.g. wrestlers. These findings indicate that a specific training leads to a specific adaptation.

#### P11M-07

### Differences and similarities in realisation of the 200 meters medley race in junior and senior category

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**Keywords:** swimming, medley

Analysis of 200 meters medley race shows the difference within tactics and functional indicators of juniors and seniors, which enables more precise planning and programming of training procedures for top juniors.

T-test and discriminative analysis have been used to determine differences between juniors and seniors, based on the 25 partial indicators of situation-related efficiency on final result. This has been applied on 36 top-graded swimmers who were finalists in this discipline, divided in two categories – juniors ( $n=14$ ) and seniors( $n=22$ ).

Variance analysis showed that the seniors are significantly faster in every time-space parameter monitored, in every lap of the race ( $p<0.01$ ) and in final result ( $t=9.09$ ,  $p<0.01$ ). Discriminative analyses were first interpreted by the energy related and tactical preparedness factor (canonical  $R=0.83$ ,  $p<0.00$ ), and than by the factor of technical economy in swimming (canonical  $R=0.75$ ,  $p<0.00$ ). They indicated domination of seniors in both components. Greater mechanical efficiency of seniors is confirmed using the discriminative function (canonical  $R=0.70$ ,  $p<0.01$ ) which integrated following parameters - stroke frequency in backstroke ( $r=0.44$ ), breaststroke ( $r=0.37$ ) and front crawl ( $r=0.31$ ).

Success in swimming depends on age, individual level of biological precocity, the level of swim quality and physical conditioning. A difference in quality of energetic-tactic preparedness related factor is found among seniors and it has a cause-and-affect relation with the factor of technical economics in swimming. Together, those factors determine success. The preference of seniors occurs in high level of mechanical efficiency defined through better motor co-ordination and technical performance as a result of long-years training procedures. Adequate level of psychophysical condition, optimum relation of stroke frequency and length along with quality performance of the turn, are determinants of technical and tactical realisation of the race and juniors should focus on them.

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#### P11M-08

### Age and maturation-related variability in motor performance among youth male Portuguese soccer players

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**Keywords:** motor performance, maturation, soccer

The present study describes the motor characteristics of a sample of 95 Portuguese male youth soccer players 10.9-16.4 years of age. Anthropometric measurements (stature and body weight), motor performance (20-meter shuttle run which is also known as PACER, 25-meter dash, standing long jump, sit-ups, hand grip strength) were measured at the

beginning of the season. Stage of pubic hair development was assessed at clinical examination (Tanner, 1962). Players were grouped by chronological age (CA): CA1: 11-12 years; CA2: 13-14 years; CA3: 15-16 years, and also by stage of pubic hair (PH1 through PH5).

Age-related variation shows that within CA1, older athletes are significantly taller ( $p<.01$ ), faster ( $p<.05$ ) and jump further ( $p<.01$ ) than younger peers. Within CA2, 14-year-old players are taller, heavier and obtain better performances in all motor tests ( $p<.01$ ) than 13-year-old players. Within CA3, comparisons between 15 and 16-year-old subjects did not show significant differences neither in body size nor in motor performance.

The players were also compared by stage of PH within each age group. At the three age-groups, least mature athletes are significantly shorter and lighter than players of more advanced pubertal status. For motor performance, differences between athletes of distinct PH status were significant for CA2. Of interest is variation by stage of puberty between age groups. For example, boys in CA1 who are at PH3 are younger by 0.7 years but stronger (standing long jump and sit-ups) than boys in CA2 who are in PH2.

The results, though based on a limited sample, suggests that age-associated variation is most marked among soccer players 11-14 years of age, while maturation-related variation is more evident during 13 and 14 years of age while. The reduced variation in older boys (15-16 years) reflects approaching maturity in late adolescent so that size and motor differences between boys of contrasting maturity status are reduced.

These observations may be useful in helping to retain and develop youth soccer players. In our opinion, regulations should be flexible to accommodate maturity-associated variation among youth soccer players.

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#### P11M-09

### Match analysis by transmitter position measurement

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**Keywords:** position pattern recognition, transmitter, game analysis

Within a game a continuously information and data flow exists. Out of this continuously data flow the information about the playing ability of a player must be extracted through a model, which is legally valid for satisfying an experts' opinion. Experts are indicating this ability as designating for performance in a soccer match. Because an experts' opinion is build out of a complex diagnostic of game flow with and without ball, a simple statistic about ball action is not enough to evaluate the playing ability. Rather there must be an evaluation of action without ball. The difficulty is located in the registration of all actions on the pitch and the evaluation of them with their importance for the game flow.

To register the interaction and the process of playing, you need an objective measurement method. This measurement tool is developed by the Fraunhofer Institute for Integrated Circuits. The System is able to record every action a player is performing with and especially without ball. The position measurement is provided by the Cairos system. This system tracks the shine pads of all players and the ball automatically by radio waves. The player's positions are measured

approximately 750 times per second. For the ball, the position is measured approximately 2000 times per second. Brought into action is a small active transmitter that works in the microwave range. The size of a transmitter, match the size of half a credit card or is even smaller. Its height is about 0.4 cm and it will be flexible. The transmitter is integrated into the shin pad of the player or into his jersey. So it is secured and it is not possible that the transmitter hurts a player. To determine a player's step frequency, his step length and his path direction, every player wears two transmitters. The accuracy of the system is less than 3 cm at 150 km/h. Position data of players and balls are raised and evaluated three dimensional. Player positions are determined every 0.0014 sec. Ball positions are determined every 0.0005 sec. So it is possible to measure a position with high accuracy, even at high speeds. The transmitted signal is received by special antennas that are fixed around the pitch. The antennas are fixed on different levels to measure accurate z-coordinates. The system uses reference transmitter to get rid of disturbing radio waves. These reference transmitters can also be used to calibrate the system automatically.

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#### P11M-10

### Skiers interval anaerobic test (SIAT): A new method of measuring anaerobic capacity in cross-country skiers

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**Keywords:** anaerobic capacity, interval anaerobic test, cross-country skiing

The time of work performed at submaximum intensity, without inhibition of aerobic metabolism resulting from intensified anaerobic glycolysis is an indicator of cross-country skier's functional capacity (Kinderman et al. 1979). The objective of the present study was to find out, if the SIAT protocol enables to define the work time performed at submaximum intensity, in which VO<sub>2</sub> is at the level of VO<sub>2</sub>max calculated with the use of progressive test.

The study group consisted of 5 skiers (aged 17-18 yrs), members of Polish National Team. Measured parameters: heart rate (HR), lactate concentration (LA), VO<sub>2</sub> (K-4 Cosmed). The protocol was employed: 20 min of warm-up, 3 exercises performed on roller skis with 2 min. of break on the ascent of 450 m at the inclination angle of 35° ± 3°. The level of VO<sub>2</sub>max was calculated with the use of progressive test.

The first exercise in SIAT is equal to maximum exercise from progressive test, as far as VO<sub>2</sub> value is concerned (634.4 ml/kg/min). During the II exercise, the level of VO<sub>2</sub> shows declining tendency in relation to the level of maximum value from progressive test (59±5.2 ml/kg/min). The reverse relation is observed in changes of HR. The maximum value recorded in progressive test was achieved in the III exercise of the SIAT (192±5 bp/min). During the I exercise of the SIAT (183±2 bp/min) none of the skiers reached HRmax and all exceeded the value of HRAT. The employed test protocol (meeting the requirements of exercise test) enabled to achieve the intensity over AT level from the very beginning.

The I exercise of the SIAT resulted in the increase of LA, and its value was close to maximum values recorded after progressive test (13.3±2.8 mmol/l). The highest values of LA

(20.2±0.3 mmol/l) were recorded in skiers, whose VO<sub>2</sub> during the III exercise of the SIAT was lower than the value of VO<sub>2AT</sub>. The SIAT enabled to achieve the effect of glycolysis intensification, which limits the effectiveness of aerobic metabolism; the lower the skier's ability for tolerance of anaerobic metabolism, the stronger that effect was.

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#### P11M-11

### Maximal force and electromyographic activity of lower extremity muscles in male soccer players

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*Keywords: soccer, strength, testing*

Strength is perceived as an important factor of the performance level of a soccer player. The purpose of the study was to measure and compare the various types of lower limb muscle strength in amateur soccer players from different local divisions in order to a better planning of training.

Eighteen amateur soccer players participated in the study, and were assigned to two groups according to the rank that their team had in the local division. Group I (n=9) consisted of soccer players from a higher local division, and Group II (n=9) consisted of soccer players from a lower local division. The participants performed the tests with by using a unique measurement device of strength evaluation. More specifically, the athletes performed tests for maximum isometric force and tests with additional weights of 5%, 10%, 20%, 30%, 40%, 50%, 60%, 80% and 100% of the maximum isometric force. Force data were recorded using Kistler pre-amplifiers. The EMG activity of the rectus femoris, biceps femoris and gastrocnemius muscles was recorded using bipolar surface electrodes. An Ariel Performance Analysis System (APAS) was used to process all collected data. The test was divided into two main phases: eccentric stretching and concentric shortening phases. For each phase, the mean force and the maximum EMG were analysed. One-way ANOVA designs were used to examine the effects of muscle action on maximum force values and normalized EMG values. The results showed that the soccer players from the higher division had scores that were statistically different from the scores, of the soccer players from the lower division, in muscle strength variables. It can be concluded that during maximal eccentric efforts, an increase in the level of resistance is a result of an increase in the EMG activity. These results may have implications in designing training programs.

#### P11M-12

### Monitoring of some indicators of physical fitness in a half-year cycle of training of top basketball players

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*Keywords: basketball, training effects, preparation period*

In order to optimally plan and program the training of top basketball players an insight into their current state of relevant abilities and knowledge (Milanovic, 1985; Jukic, 1998) is necessary. The diagnosis of the state of athletic shape in basketball players is used for that purpose. The purpose of this paper is the monitoring of the changes of some segments of sport preparedness during the half-year cycle of the training of top basketball players.

The sample of examinees was comprised of 11 senior top basketball players (1-A Croatian Basketball League, BC Karlovac), aged 18 - 27 years. Five tests were used for the assessment of the basic and specific sport form. The changes in the variables were analysed at four time points with an average interval of 30 days between the measurements.

During the preparation period and during the first and the second competition phase in the time from 2nd August 1999 till 19th December 1999 (118 days) one hundred and twenty-two training units were carried out and nineteen games were played. Within 241 hours of training there were 47 days of rest (half-day and whole-day rests). The average duration of one training unit was 108.8 minutes, whereas the average intensity was 80% of the maximum.

By means of the series of univariate analyses the statistical significance of differences between the repeated measurements was determined in each variable for the assessment of motor abilities. The results of the multivariate analysis of variance show that the applied training process led to the statistically significant differences (p-level 0.000) in all variables between the first and the other measurements.

The decrease in the values of indicators in the analysed periods did not occur and the reason for this may be explained by several details connected with the system of training, competition and testing of abilities: 1. Competition system was obviously not too demanding; 2. The training system gave the players enough time to recover; 3. The training system was optimally designed; 4. The battery of tests for the assessment of sport preparedness was relatively small and it is for certain that the lack of tests for the assessment of all motor and functional abilities limits the conclusions of this research to the applied variables.

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## Poster Session

## Training and Testing 5

P11N

## P11N-01

**Match-play load in roller hockey****Blanco Alfonso, Ensenyat Assumpta**

INEFC Lleida, Spain

*Keywords: team sports, game play load, roller hockey*

Roller hockey is a team sport, where two teams each with four players and a goalkeeper compete for 50 min on a 40 x 20 m court, trying to introduce the ball into the opposing team's goal. In this study, an exhibition match-play between two professional roller hockey teams was analysed with the purpose to examine the load profile and to investigate the relationship between load levels and the changes of cortisol and creatin kinase (CPK) blood levels.

Four male professional field roller hockey players and one goalkeeper (26.9 (DE 4.3) years; 179 (DE 4.36) cm and 74.46 (DE 7.79) kg) of the Premiere League volunteered to take part in the study.

Before and after the match-play venous blood samples were drawn for the determination of cortisol and creatin kinase. During competition participation time and heart rate were recorded using a heart rate monitor (Polar Vantage NV) and processed using Polar Precision Performance software to estimate load levels by means of Training Impulses (TRIMP) and the sum of heart beats (Total heart rate) performed during the match-play.

The data were treated with descriptive statistics, Wilcoxon nonparametric test and Spearman correlation index. Significance level was set at  $p < .05$ .

Match-play participation time ranged between 31 min 25 s and 44 min 04 s. During the game field, players showed a higher ( $p < .05$ ) heart rate (mean 167 (DE 17) beats/min) than the goalkeeper (R) (mean 149 (DE 12) beats/min).

Load levels were also higher ( $p < .05$ ) in field players and ranged between 239 and 395 for TRIMP and between 4680 and 7250 beats.

Cortisol and CPK blood levels increased significantly ( $p < .05$ ) after the match-play with a mean increase of 9.5 µg/dl and 65.3 U/L respectively. No significant correlation was found for cortisol or CPK and match-play load.

According to these results, a roller hockey match-play appears to produce a moderate physical stress for trained elite hockey players. Relationships between load and biochemical markers are difficult to evaluate due to the complex interactions that determine physical stress.

## P11N-02

**Endurance diagnostics and GPS-technologies in cross country skiing: Spirometry and lactate measurements in top level junior athletes****Knuth Sarah, Osterburg Astrid, Krämer Alexander, Mester Joachim, Roth Ralf**

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*Keywords: cross-country skiing, GPS, endurance diagnostics*

By combining techniques of traditional performance diagnostic with the use the GPS-technology new possibilities for testing athletes can be developed.

In the present study the combination of these methods are used for studying five members of the Junior National Nordic Combined Team (age:  $17.9 \pm 0.6$  years; height:  $181.3 \pm 5.8$  cm; body weight:  $68.7 \pm 1.0$  kg) in cross country skiing. They were provided with a heart rate monitor, a portable spirometry and GPS-equipment. The athletes covered a cross country skiing track of 3,6 km in the range of race specific intensity. Before the race, after and three minutes after the exercise blood samples for lactate measurements were taken from the ear lobe. During the run heart rate, respiratory parameters, the altitude profile, velocity and acceleration were recorded continuously.

Physiological parameters such as heart rate, oxygen uptake, carbon dioxide output and respiratory quotient and velocity during exercise react in the context to the profile (altitude). Between heart rate and oxygen uptake there is a significant positive correlation ( $r=0.6$ ;  $p<.05$ ). Due to the change of altitude speed alone cannot be used as an indicator for physical load and shows a significant negative correlation to heart rate ( $r= -0.23$ ;  $p<.05$ ) and oxygen uptake ( $r= -0.38$ ;  $p<.05$ ). The lactate concentration before, after and three minutes after the exercise indicate clear differences in the use of aerobic and anaerobic energy yield. Apart from the first test person with the highest value of 13 mmol/l and the best racing time, the other four subjects oscillate in an area of  $8.2 \pm 0.7$  mmol/l.

GPS-technologies allow a much more detailed analysis of speed and profile during the whole race. If physiological variables such as  $\dot{V}O_2$  are recorded simultaneously new insights in the dynamic and complex interaction of metabolic and physical parameters will be possible. In order to get more information about the combination and correlation of these diagnostics further studies are necessary and already planned.

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## P11N-03

**Applied biomechanics - technique training with pressure soles in alpine skiing and speed skating****Spitzenpfeil Peter, Hartmann Ulrich, Wolf Claus-Dieter**

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*Keywords: alpine skiing, speed skating, technique training*

To improve movement technique in sport appropriate feedback is necessary. The movement analysis of beginners mostly can be done by eye or ordinary methods as video or photo. On high performance level in most sports differences in motion are hard to identify. By using biomechanical methods as 2D or 3D kinematics, dynamometry or EMG these small differences may be analysed but those methods need a lot of time (e.g. 3D kinematics), can only be used stationary (e.g. force plate) or are very laborious (EMG). However, in many sports it is necessary to support trainers and athletes with scientific methods to achieve top level performance.

The aim of the presented studies is to show the applied use of pressure soles in technique training of alpine skiing and speed skating to answer specific questions: 1. Are the top level female racers of the national alpine ski team able to achieve a pressure distribution of inside/outside leg of 40/60% in turns? 2. Is the time for push off in speed skating dependent on different skating shoes?

The diagnostics were done with the elite women of the German National Ski Team in training sessions for giant slalom, slalom and easy skiing and with some single male athletes of the National Speed Skating Team. As measurement system the PAROTEC sole of PAROMED was used. On each sole 24 pressure sensors embedded in hydro cells were placed. The soles were connected to a data logger (weight: 570 g) fixed on the back of the test person. The measurement frequency was 250 Hz and the time 20-40 s. The evaluation of data was made by a special programme (ADGRAPH by BASIS) which facilitates the combination of evaluated data and video. For evaluation and presentation the sum of the raw data out of the 24 sensors for each sole was calculated and plotted in a line draw. Further the percentage distribution between left and right foot was computed and a bar plot generated. In a third window the amount of pressure on each sensor was shown by colour and/or some sensors were combined and shown as bars. Continuous measures as diagnostic and feedback showed that the improvement of the distribution in turns can be achieved. Neither the analysis of the video nor the sensation of the athletes themselves are able to produce comparable results, whereas the objective should be the adaptation of sensation and positive results. Similar findings were made in speed skating.

#### P11N-04

### Self-perceived and actual indicators of motor abilities in children and adolescents

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*Keywords: fitness, self-perception, school children*

It is well known that self-perception has become very important to characterize both physical and psychological adaptation. The aim of this study was to estimate the relationships between self-perceived and actual indicators of fitness in different sex and age of children and adolescents.

A total of 525 boys and girls aged 10-17 years were studied. They were divided into four age groups (10-11, 12-13, 14-15 and 16-17 years of age). Height and body weight of subjects were measured and BMI was calculated. Nine skinfolds were measured. All 9 skinfolds were summarized as a body composition parameter. The following EUROFIT (1988) tests were used to measure motor abilities: 20 m endurance shuttle-run, handgrip dynamometry and sit-and-reach. Self-perceived fitness (fitness, endurance, strength, flexibility and body composition) was assessed using a slightly modified version of a questionnaire by Delignieres, Marcellini, Brisswate, and Legros, which has been described by Lamb and Haworth (1998).

The present study demonstrated that Estonian children and adolescents who are moderately physically active and whose basic motor abilities are at the medium level perceived their endurance, flexibility and body composition satisfactorily. However, they did not perceive significantly their strength.

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#### P11N-05

### Modelling exercise for health

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*Keywords: exercise, modelling, mechanical load*

Exercise for health and fitness, constitutes a group of physical activities performed by a large number of participants. The main objectives of these physical activities are to provide healthy mechanical and metabolic stimuli as well as self-enjoyment. Our major concern is how to increase intensity of exercise, maintaining safe levels of mechanical load.

One important characteristic of most of the recreational physical activities - such as step exercise - is the repetition of exercises that produce forces of low magnitude (1 to 2 BW) and high frequency (3750 to 4050 times on a 30 minutes session, using music speed at 125 to 135 bpm). Mechanical load is due to magnitude of forces but also due to the frequency of forces applied on the body. The knowledge about the prevalence and type of musculoskeletal disorders associated to fitness activities is essential for exercise prescription and technique, since participant goals are related to fitness and health. Understanding the biomechanics of the lower limb during Step exercise is very important for therapists to design rehabilitation programs and also for exercise prescription.

An analytical model of the lower limb is being developed to estimate the net forces and moments on ankle, knee and hip joints, during Step exercise (work in progress). Using a 130 bpm music speed, several tasks were performed by one subject (female, 1.70 m height, 60 kg weight, 33 years): basic step (BS), knee lift (KL), knee repetition (KR), knee hop (KH) and run (RU). Eight repetitions of each task were performed using a AMTI force platform (17 cm height) for stepping up and a Kistler platform on the ground for stepping down. Digital image and ground reaction forces (GRF) were collected. Data will be processed using Biopac software and APAS Ariel System. GRF will be determined, and will be used to calculate net joint reaction forces (JRF) and moments, by inverse dynamics.

The advantage of modelling exercises for health is that these kinds of studies provide more information about mechanical load over a large range of performance conditions, which will help to correct technique and prevent musculoskeletal disorders.

#### P11N-06

### Elaboration of a specific test to evaluate the execution time of the punch techniques of karate

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*Keywords: testing, karate*

The execution of the punch techniques is very important to excel in karate. We started an experimentation of a specific field test (SOP Test). It permits an exact measure of the duration of the technique and of its speed.

We used a computer system with two photocells. The first one permits to value the technique Gyaku Zuki performed from a long distance (150 cm), the second one permits to value the techniques Gyaku Zuki and Kizami performed from a short distance (100 cm). The experimentation was carried out on 24 karateka, 12 amateurs (age 22+-4, weight 71+-5, height 173+-6, practise years 10+-2), and 12 professionals (age 24+-3, weight 71+-9, height 179+-7, practise years 16+-4). To value the reliability of the test, each athlete had to execute four times three techniques. This trial was repeated in the two following days. To study the validity of the test we did a cross comparison between the professional group and the amateurs one. The objectivity is granted with a precise standard procedure.

The results of reliability (test-retest correlation) pointed out the  $r$  values included between 0.82 and 0.93 for all the parameters considered in the 2 groups ( $p<0,01$ ). In the study of the validity the tests on a short distance put in evidence the greater rapidity of the professional athletes, who had better results than amateurs with differences of 77% for the Gyaku Zuki ( $p<0,05$ ) and of 81% for the Kizami ( $p<0,05$ ). The tests executed on the long distance, instead, pointed out a clear and strange superiority of the amateurs, with a difference of 49% ( $p<0,001$ ).

The results of the experimentation permit us to point out in the SOP Test, interesting reliability characteristics, demonstrated by the high correlation test-retest. The test put in evidence the better rapidity of execution of the professionals in the performance of harm technique on short distance. The better rapidity of execution of the amateurs of the Gyaku Zuki on the long distance is probably due to the technical-tactical characteristics of the professional team we studied: these athletes use normally leg techniques on the long distance. Also for this reason we are improving a test to value the speed of the kick techniques (SOK), which will be the aim of our next study.

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#### P11N-07

### Comparative analysis of the systems of classic and block periodization in the shoot boxing

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**Keywords:** *periodisation of training, shoot boxing, combat sport*

We started an investigation to compare the effects in combat sports (shoot boxing) of the classic training periodization system in which the physical qualities are developed side by side, and the blocks periodization system (Verchoshanskij) oriented for the development of single physical qualities during succeeding periods.

We divided 20 shoot boxings of regional level (age 19+-3; weight 70+-11; height 176+-8) in 2 groups of 10 boxers each with a similar competitive level. The training lasted 15 weeks; the scheduling organization was different in the 2 groups. The 1st group trained on the base of the classic periodization system, the 2nd trained with the blocks system for the training of: 1) Endurance 2) Fmax, 3) Fexpl. 4) technique and rapidity 5) special endurance. Each block lasted 3 weeks. The subjects had to do a test battery every 3 weeks with: 3 trials to value the Fmax, 3 for the Fexpl., the rapidity of 2 throwing techniques (TEP test), of the hitting techniques (SoP/SoK test), Cooper test, a circuit for the specific

endurance. The data were statistically analysed (mean, SD, Anova 2way w.r.) to verify the variation.

Both groups had a significant increase (between 9% and 69%;  $p<0,001$ ) with similar results in many tests. The increase of the 1st group was linear; the 2nd had a more varying trend. We remarked significant decreases of the specific rapidity (-9/11%;  $p<0,05$ ) at the 1st block (endurance). The percentage of increase of Fmax.rel., of Fexpl and of the rapidity of the throwings was higher in the 2nd group, but this difference was not significant. The difference of the hits rapidity was significant: the 1st group had a better result than the 2nd group (63% vs. 57%;  $p<0,01$ ). The 1st group also had a better result for endurance (69% vs. 62%;  $p<0,01$ ) while the 2nd group had a significantly higher increase in the specific endurance (54% vs. 48%;  $p<0,001$ ) due to the last training block.

The results are near our expectations and the indications of sport literature. The periodization training block model was only partially adaptable to the necessities of the not high level athletes. Our aim is to go on with this study in close future.

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#### P11N-08

### Physical growth data and motor abilities measured in 677 Italian children aged 6.5 years: a longitudinal design

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**Keywords:** *motor abilities, children, physical growth*

Nowadays there is a great deal of public concern regarding the health status of children. This is because diseases caused by lack of movement and unbalanced diet are becoming more prevalent in young children. It appears that children prefer spending their time in front of the TV or playing computer games rather than playing on streets or playgrounds. However, reduced physical activity might also be attributed to environmental changes such as increases in urbanisation and car traffic. Undoubtedly, the conditions of living and moving are changing and might be responsible for diseases such as obesity. The goal of our survey is to detect the changes in physical growth and motor abilities during five years of primary school education in one Italian city (Pesaro). The research will last until June 2006.

677 children aged on average 6.5 were chosen as a target of our survey. Eight motor ability tests were chosen. Some of them, e.g. standing long jump and mini-basketball throw for distance, are used internationally. Others were introduced by our research group and are presently under validation. A team of two physical education teachers and one sport physician collected the physical growth data: 30 variables including height, weight, body composition, circumferences and spinal, knee and foot curves. To measure environmental influences, a 26 item questionnaire was given to children and parents, to quantify variables such as family situation, after-school activities, etc. Children performed at least one hour per week motor activity.

We found out that males are a slightly heavier and taller than females and perform better in the standing long jump and ball

throwing. However, none of the differences are statistically significant. Mean BMI values, both for males and females, are under threshold for overweight and obesity, according to the latest Italian children charts. 6.5-year-old males are more likely to play one sport than females. This is just the first measurement out of five planned in five years. It will be interesting to observe the evolution of the variables during the forthcoming years.

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## P11N-09

### Monitoring tapering in adolescent swimmers

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*Keywords: tapering, adolescent swimmers, training diaries*

Tapering is commonly used in well-trained athletes, and it is questionable if it is useful for adolescent swimmers with less technical competence and poorer performance. Training logs and the profile of mood states (POMS) have been widely used to monitor training and tapering in elite swimmers (Hooper et al. 1993 and 1999), much is to be done in the reliability of these instruments in order to monitor training improvement in adolescent swimmers. Therefore, the purpose of the present study was to monitor the tapering period in adolescent swimmers evaluating both performance and training diaries.

Nine male (16±0.7 yrs. 63.6±7 kg, 176±8 cm) and six female (14.5±1 yrs. 56.6±3 kg, 167±5 cm) swimmers performed 6 times a 300 m with 1 minute recovery before and after a 2 week tapering period (Maglischo et al.). Blood was collected for lactate analysis at rest, after each 300 m, and during recovery. Performance was evaluated by comparing the speed at the 4 mmol/l of lactate concentration. Subjects filled in a daily 32-item POMS and a training diary during tapering. Data were compared via a paired student t-test ( $P<0.05$ ).

During the tapering period there was a 21% reduction in training volume and a 30% reduction in training frequency. Lactate concentrations were not different during the tests but were significantly lower during recovery post tapering. The speed at the 4 mmol/l did not vary with tapering, and no difference was observed between boys and girls.

POMS showed a 25% decrease in fatigue scores and a 5 % increase in the scores of vigor compared to the 6 weeks prior to tapering.

Performance was not improved with tapering. It can be hypothesized that the tapering itself was of no use for this population of swimmers, that the performance increments are not visible at this stage but some time later after tapering or that the test they were asked to perform was too difficult for their technical level. Although the training diaries and the POMS showed individual improvements, the overall means were not statistically different, and more specific questionnaires for this age should be administered.

## P11N-10

### A simple assessment of aerobic fitness in field conditions

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*Keywords: aerobic fitness, field testing*

Aerobic fitness - AF is frequently considered the most important aspect of health-related fitness. The conventionally accepted physiological criterion of AF is maximal oxygen uptake - VO<sub>2</sub>max. When VO<sub>2</sub>max is not directly measured, it can be estimated from performance motor tests. The using of motor tests for indirect determination of VO<sub>2</sub>max is based on dependence between the energy cost of exercise and exercise intensity.

Energy output for physical activity (expressed indirectly by VO<sub>2</sub> per unit body mass) can be estimated from the intensity of exercise by means of various nomograms and/or equations. We are in agreement with other authors in believing that the model relating energy cost of cyclical exercise should be as simple as possible. Therefore, only linear equations may be used to relate intensity of physical activity to VO<sub>2</sub>. These relationships are linear in the submaximal range of intensities. Over 95% of all leisure-time physical activities and/or physical activities that are realized in non-trained healthy subjects lie in the submaximal range of intensities. If we extrapolate linear relationships between VO<sub>2</sub> and exercise intensity to maximal exercise intensity, the inaccuracy of the VO<sub>2</sub>max determination resulting from the intensity of exercise increases by approximately 5%. From this we can use the linear relationship for determining VO<sub>2</sub>max from physical performance. Although minimally a 15% total prediction error exists, motor tests can be used to estimate AF with less risk than maximal tests in laboratory and they are particularly useful for testing large population samples in a short time. The purpose of this study was to determine norms for the estimation of AF with regard to Czech standards and with regard to general relations between the mean velocity of the cyclical movement in a field conditions and an energy required for this activity.

These norms were derived from a Czech sample, incorporating relations between speed of movement and energy required for this activity expressed indirectly by VO<sub>2</sub>. The basic element of evaluating AF under field conditions is the mean velocity of walking or running on a 2000 m track, and/or cycling on a 5000 m distance, and/or swimming on a 300 m distance. The standards have been prepared for males and females aged 10-70 years, making it possible to estimate "poor", "good", and "excellent" levels of AF and physical performance. The error of assessment of VO<sub>2</sub>max and thus AF level varies by about 15%.

## P11N-11

### Special speed and endurance in the training loads in many-years training cycle

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*Keywords: endurance, training, testing*

The Marathon is a sport widely performed in the world. In the marathon races there are many competitors of different sport levels. The Marathon race is one of the most difficult events in track - and - field. Marathon runners should also have appropriate mental attitude which enables them to overcome

psychical stress. Training methods in this sport are continuously being changed due to dynamic development in the Marathon race. The structure of loads as well as volume is being changed. The purpose of this paper is the analysis of training loads in Polish Marathon runners at particular stages of their development. Dynamics of particular training means which affect speed and technique as well as special endurance has been determined. Relative speed is a training mean during the preparation period which can be considered as a speed-endurance training. Running rhythm improves running technique thus it influences the development of speed. Special endurance improvement is a form of training work which directly affects the adaptation for physical effort in sport contest. From training point of view it is the most difficult phase of a running training. It calls for optimum running and endurance preparation.

The training loads of four Polish marathon top runners from 1994-1998 were analysed. Their best records ranged between 2:10.50-2:13.46. Only the training means were analysed, which greatly influence speed and running technique as well as special endurance. A group of training means which are used for improving speed consists of: relative speed and running rhythm. The volume of contest loads and the covered training distances are among the means for developing special endurance. The gathered material has been analysed. The training loads were obtained:

1. at the age of 22 (the last year in the youth category).
2. in the year a competitor took part in the Marathon for the first time.
3. in the year the examined competitor got his/her best result in the Marathon (fig. 1,2)

Training means data has been given in percentage ratio to all the loads (all the kilometres). Material has been formulated by basic statistic methods, results have been graphically presented.

#### P11N-12

### How does low back pain influence the center of mass deviation from the center of base of support in various dynamic conditions

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*Keywords: proprioception, low back pain, dynamic balance*

It is mostly accepted that muscular system, as well as connective tissues and neural system are involved in the pathophysiology of clinical low back pain LBP (1). Low back pain is associated with asymmetrical weight distribution on feet. Most of the previous studies on balance are based on static conditions. In this study, the balance impairments of the low back pain patients are assessed and compared with healthy subjects in various dynamic conditions in which vestibular, visual and proprioceptive systems have been challenged.

Twenty-one low back pain female patients between 20 to 40 years old and 19 healthy aged matched women voluntarily participated in this experiment. A dynamic stability platform system (BIODEX) was used to evaluate the deviation of the center of gravity (COG) from center of base of support (BOS) in overall (total), anterior-posterior (AP) and medio-lateral (ML) directions under various conditions in which visual, vestibular and proprioceptive input were manipulated. These tests were performed on two instable levels of foot platform, namely very instable and almost stable. Multivariate analysis of variance was used for statistical analysis.

The deviation of the COG in LBP patients was significantly greater than that of the normal group in all conditions ( $p=0.001$ ). The influence of the manipulation of all balance systems resulted in larger COG deviation in patients than in normal group. The most abnormality was occurred when the three balance systems were manipulated at the same times. The deviation of COG from BOS in LBP Dynamic balance of low back pain patients was affected. Removal of visual information, manipulation of head's normal position and instability of base of support resulted in more balance abnormalities in LBP. There was an interaction between visual, vestibular and proprioceptive manipulation factors. Body balance must be considered in both detection and rehabilitation of LBP.

#### P11N-13

### 10 years old soccer player's thinking level measurement with psychomotoric achievement

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*Keywords: soccer, intellectual abilities, psychomotor abilities*

The aim of the present study is to verify whether thinking level determines the team performance at 10 years old age group or not. It is supposed that children are in the same physical and technical level. The present experiment is addressed to check the determination level of children thinking about the team-work.

22 children from VASAS SC and 13 children from IKARUSZ SE, all of them were born in 1992 were participated in this experiment. According to the anthropometric, neither of the children is retarded or accelerated. So it is hypothesized that the difference is in the thinking level. The children had no previous knowledge about the tests and all of them play soccer for three or four years. Psychomotoric abilities were examined with signal-detection and simple reaction time measuring module of the Wiener Test System, Fleishman test, balancing test, kinaesthetic test, and rhythmic test. Special soccer test I was used to estimate the shifting from concrete operational stage to formal operational stage. The technical skills of the children soccer players are tested with special soccer test II.

According to our findings there is no significant difference between the two groups in technical level, space orienting with the ball and rhythmic tests as well. While there was a significant difference concerning special soccer test I for the assessment of thinking level, space orienting without the ball and in exercises measuring kinaesthetic and balancing abilities.

The fact, that there is no significant difference in the soccer test II, measuring the technical level but there is significant difference in the soccer test I measuring the thinking level, we can conclude that differences in performances of matches are not caused by technical abilities, but by the thinking level. The group which provided better results in the field of soccer is in formal operational stage. Planning is the result of formal operational stage. Since there are significant differences between the two groups concerning not just kinaesthetic ability but also balancing, the group which provided better performances has reached formal operational stage in the special area, in soccer.

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## P11N-14

**The difference in some jumping tests between football players in the first and second class****Embersic Danilo Slavko, Marija Mismas Pintar, Miha Verbec**

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*Keywords: football, jumping tests, students*

Javelin throw showed in contrary to other throwing disciplines highest progress in the last ten years especially in case of male. We could search reasons for progress in technical adaptation to a new type of javelin which demands better physical preparation especially in strength and power. However, from the kinematical and dynamical point of view, maximum release velocity, optimal release angle and release height represents three most important factors that define result in javelin throw. Especially release height is mostly defined by height of the athlete. The aim of the study was to find the relationship between morphological parameters and javelin throwing distance in the best European juniors.

Twelve top male and eleven male participated in this study. Immediately after the competition we took eight morphological data according to International biological program (IBP). Descriptive statistic parameters were calculated for all those parameters. For evaluation of competition performance we used the method based on an expert system. This system is based a on prognostic performance tree. On the highest level we could find five knots (body weight with 20%, longitudinal dimensions with 30%, transversal dimensions with 10%, and voluminous dimensions with 20% and the function index with 20% of success). Pearson's correlation coefficient was used for correlation between all morphological data and success in javelin throw.

Deviations from the regression straight line are for males very high. The winner got the lowest score for his morphological structure, but the second best in the competition got the highest score. In contrary to discus and shot put throwers where body weight and longitudinal dimensions are very important, in the case of javelin throwers we can see that body composition does not differentiate best throwers from the average ones. The minor and skinny javelin throwers are also able to achieve top performance, especially if they compensate their minorities with other motorical abilities, such as speed, flexibility and elastic muscle power. In case of female the potential model shows higher correlations with success in javelin throw, the values are near 5% alpha error statistically significant.

## P11N-15

**The dynamic equilibrium control of children with cerebral palsy compared with normal subjects****Farahpour Nader, Sharifmoradi Keyvan, Sadegh Saba Mohamad, Mehdi Mohamad Taghdiri, Allard Paul**

Bu Ali Sina University, Iran

*Keywords: proprioception, dynamic balance, cerebral palsy*

Cerebral palsy (CP) with an incidence of 1.5% to 2% has clinical importance. In CP, usually the functional behavior of the neuromuscular system is severely affected. A clear understanding of the mechanism and function of the neuromuscular system in CPs, more especially in dynamic condition, can improve the quality of the related treatment. The objective of this study was to evaluate the impacts of CP on the dynamic balance of young CP children in various conditions.

Ten CP children between 8 to 15 years of age, with the mean height and weight of  $(1.35\text{m} \pm 0.09\text{m})$  and  $(30.8 \text{ kg} \pm 5.7\text{kg})$  respectively participated in this experiment. Twenty healthy children with similar age, with the average height and weight of  $(1.34\text{m} \pm 0.05\text{m})$  and  $(36.2 \text{ kg} \pm 11.2\text{kg})$  respectively, were also served as a control group. A new stability platform system (BIODEX) was used to evaluate the dynamic balance of the subjects during standing positions with and without shoes. In order to stimulate the proprioceptive system the foot platform was set in three different stability degrees such as low, mid and high stability. On each condition, the deviation of the center of gravity (COG) from the center of the base of support (COBOS) in different direction was obtained. Results showed that the mean deviation of COG among CP children was significantly 2.5 times greater than that of the normal group ( $p=0.001$ ). The deviation in AP direction in both groups was larger than in ML direction. When the stability of the foot platform was set in loose condition, the deviation of COG in experimental and control groups was significantly increased by 0.4 and 2 degrees respectively. Wearing shoes decreased the deviation of COG significantly, while it did not have any significant effect in normal subjects.

The dynamic balance of the CP patients was significantly affected. In patients, the Proprioceptive system had a poor function compared with normal subjects. Wearing Shoes had an important influence on patients' balance. These results show the importance of the shoes on the treatment procedures of CP children.

## Poster Session

## Training and Testing 6

P110

P110-01

**Effects of seasonal training on resting autonomic control of heart rate in young athletes****Perini Renza, Tironi Adelaide, Cautero Michela, Tam Enrico, Capelli Carlo, Di Prampero Pietro**

University of Brescia, Italy

*Keywords: heart rate variability, autonomic nervous system, exercise capacity*

The effects of changes in physical fitness on heart rate (HR) autonomic control have been evaluated by means of HR and blood pressure variability spectral analysis in a group of young swimmers (3 males and 6 females; age range: 14-18 years).

Before (B) and after (A) 5-months athletic season, maximum oxygen uptake (VO<sub>2</sub>max) was determined during incremental cycle test up to exhaustion and HR and blood pressure (PortaPress) were continuously recorded at rest both in supine and sitting position (10 min each). HR, mean (MBP), diastolic (DBP) and systolic (SBP) blood pressures and stroke volume were calculated by BeatScope software. Power spectra of HR and SBP variabilities were estimated by an autoregressive method. Total power, power in the low frequency (LF, 0.04-0.15 Hz) and high frequency (HF, 0.15-0.4 Hz) bands, in normalized units (nu, percent of total minus power below 0.04 Hz), and the ratio between LF and HF powers for HRV and total power and LF power for SBP variability were calculated.

After training VO<sub>2</sub>max was about 10% higher than at B ( $p < 0.05$ ); HR was significantly lower (9 b/min) in both supine and sitting positions, while blood pressures decreased in supine position only (20% for SBP; 26% for both DBP and MBP) and no change in stroke volume occurred. Total power and LF and HF nu powers of HRV were comparable at A and B in both body positions. In sitting position LFnu and HFnu turned out to be higher and lower, respectively, than in supine position regardless of the observation time ( $p < 0.05$ ). The LF/HF ratio resulted about 3 times higher in sitting than in supine position independently of training. Both total power and LF power of SBP variability were not influenced by body position and did not change at A.

Athletes improved their fitness level, in 5 months of training induced an increase in VO<sub>2</sub>max and a decrease in resting HR and BPs. In contrast no difference in HRV and SBP spectral parameters could be observed over the season, indicating that no modification in cardiac sympatho-vagal interaction and autonomic vascular control occurred.

These results suggest that the relation between the fitness level and the autonomic spectral indices seems to be rather feeble and that training seems not to induce any short time effect on autonomic modulation of cardiovascular parameters.

P110-02

**Heart rate and heart rate variability during a microcycle with different training regimen****Sturm Leopold, Hofmann Peter**

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*Keywords: overtraining, heart rate variability, training regimen*

At present it is usual to perform a ramp test in the laboratory to get basic values for loads within the subsequent macrocycle (load-induced). But an athlete's performance is underlying daily fluctuations. Therefore it seems necessary to adapt the load adequately every day in order to optimize the outcome (strain-induced). Changes in the resting heart rate reflect autonomic functions. Parasympathetic activation reduces heart rate while sympathetic stimulation leads to an acceleration. Heart rate variability (HRV) gives a possibility to evaluate the autonomic input on the heart under different physiological conditions. The aim of the study was to evaluate the imprints of different microcycle training regimens (constant load versus constant strain) on the autonomic nervous system and further to examine signs of overreaching.

Two different groups of trained men (A:  $27 \pm 7$  age,  $179.8 \pm 4.3$  cm height,  $74.9 \pm 3.5$  kg weight; B:  $29 \pm 8$  age,  $180.8 \pm 4.9$  cm height,  $72.7 \pm 6.4$  kg weight) performed a daily cycling ramp test until exhaustion for a period of 17 days. After the PRE-phase (3 days for establishing performance), the following 7 days (TEST-phase) an exhaustive ramp test (T1) followed by a 30 minutes exercise (TU, 87% heart rate maximum from T1) and another second maximal ramp test (T2) were performed daily. The subsequent POST-phase (7 days, one ramp test each day, no training) parameters of performance and autonomic modulation (spectral analysis with low/high frequency components; Poincaré plot with standard deviation of beat-to-beat RR interval variability SD1/SD2 in short/long diameter of ellipse) were observed. Group A kept the exercise load constant, while group B varied each day dependent on the individual heart rate performance. In the morning an active orthostatic test (OT) was performed and HRV was recorded.

In this study performance kept stable in both groups and no clear outcome regarding distincts in HRV dependent on two different training regimen could be detected. Increased values of heart rate in recumbent position as well as elevated index SD1/SD2 in POST-phase and a LF/HF ratio shifting towards enhanced sympathetic drive, indicates more cardiovascular stress in group A.

Obviously exercises of minutes duration are too short to indicate clear signs of overreaching/ overtraining in moderately trained subjects.

## P110-03

**Testing of Estonian young female volleyball players' physical abilities considering their body constitution**

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*Keywords: testing, volleyball, adolescents*

To improve adolescents volleyball coaching in Estonia, along with other information, we need objective data on young female volleyballers physical abilities and body build.

The sample consisted of 46 young female volleyball players aged 13-16 years (average age 14,61). All the subjects passed the following seven validated tests of physical fitness: two vertical jump performance tests, maximum aerobic endurance test, stomach muscles strength test, the flexibility test, speed of movement test, upper body and arms strength test. The girls were measured according to the classical methods of Martin. A total of 43 body measurements, including 11 skinfolds, were taken. The measurements included body weight and height, 9 length measurements and 6 breadth - depth measurements. Thickness of limb bones (femur, ankle, humerus and wrist breadth), 15 circumferences and 11 skinfolds were measured.

All the tests of physical abilities except that of stomach muscles strength and flexibility showed correlation with individual anthropometric characteristics. Thus, jump tests correlated with all the measured variables except indicators of body fat content (BMI, skinfolds, amount of subcutaneous adipose tissue in kilograms and its percentage of body weight). Medicine ball throwing test correlated with the general size of the body, upper extremities length, bone-muscle strength of the trunk and extremities (extremities circumferences, extremities bones thicknesses); there was, however, no correlation with body fat content. Endurance test showed negative correlations with all body characteristics, and smaller girls achieved better results. The results of the speed test were worse in volleyballers with higher body fat content.

Dependence of physical ability tests results on body build could be predicted by multiple regression analysis. We applied two parallel models. In the first one, the arguments included only age, height and weight; the second model contained a combination of 3-4 other variables that had revealed significant correlation with the test studied. We found that, although the first model was significant in the case of all the tests, determining their variability within 24-75%, the second model predicted physical ability test results with greater precision 42-89%.

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## P110-04

**Longitudinal study of VO2max, velocity at VO2max (VelVO2max), running economy (RE) and velocity at 4 mmol blood lactate concentration (V4), in well trained male distance runners.**

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*Keywords: tracking, middle distance running, muscle properties, simulation*

The longitudinal study of the alterations of average values and tracking in some physiological parameters determining the performance of middle distance runners, was rarely undertaken (Jones, 1998). The appreciation of tracking can be made by the observation of index K of Choen. The purpose of the present study was to document changes in running economy (RE), maximal oxygen consumption (VO2max), maximal aerobic velocity (VelVO2max) and velocity at 4 mmol blood lactate concentration (V4), in well trained distance runners.

18 Portuguese male well trained distance runners were evaluated 6 times throughout 2 following years. The V4 was determined by linear interpolation, from a land test. The respiratory exchanges were evaluated (breath-by-breath) in treadmill. The determination of the RE (ml/kg/km), at an intensity of 90% of the V4, was made from recta of regression that associates the values of the VO2 with the race speed. The VO2max and the VelVO2max were evaluated in the following of the test of evaluation of the RE. The VelVO2max was determined by the observation of the first level at which VO2max occurs.

The VO2max is the only parameter with significant alterations all along the time of study. The impaired comparison shows that from moment 1 (M1) to moment 2 (M2) only the RE improves; from M2 to M3 the RE and the V4 get worse; from M3 to M4 the V4, VO2max and VelVO2max improve; from M4 to M5 the VO2max and the VelVO2max get worse; and from M5 to M6 there are no significant differences. A positive or negative variation can be observed in the athletes both with higher and lower levels. The values of index K were: 0,54 for the RE; 0,70 for the V4; 0,55 for the VO2max; and 0,71 for the VelVO2max, based on the division of the distribution in tercis.

The analysis of the results shows that, despite some oscillations, the remaining parameters do not significantly vary all along the time of study. This resistance to the alteration was also found in other studies (Brisswalter and Legros 1994). As for the tracking, we can see that the RE and the VO2max present moderate values and the V4 and the VelVO2max show high values. In conclusion, the VO2max was the only parameter where significant alterations occurred; a strong canalization of the athletes exists, that is, the athletes tend to remain in the same tercil of the distribution all the time.

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P110-05

**Analysis of training adaptations based on the results of a battery of tests**

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*Keywords: training, testing, volleyball*

The great performances obtained by the Brazilian Volleyball teams at the adult level reflect the program organized to prepare the athletes since they are 16 years old when they are first gathered as a national team for training for the South America Championship. During this period and according to the macrocycle, a battery of tests is applied to better verify the training adaptations demonstrated by the athletes which results contribute to adjust the individual workloads of training and also to get a better knowledge in how the intensive training affects the response of the young athletes measured by a battery of tests.

The sample was composed of 12 athletes (Age: 16,63±0,47years; Height: 196,03±4,5cm; Weight: 83,85±8,7kg) of the Boys' Youth Brazilian National Team who took part in the five months macrocycle of preparation aiming the South America Championship of 2002. The macrocycle was divided in microcycles composed of 11 sessions per week, which combined technical, tactical, general conditioning and weight training. The average time for each session was about 120 minutes. The battery of tests was applied during three different moments of this period (Test 1, Test 2 and Test 3) and included anthropometric measures, Agility tests, Medicine-Ball Throw, Aerobic Power Shuttle Run Test, Squat jump, Countermovement jump and the Jump anaerobic resistance test-15 seconds conforming prescribed by BOSCO et al.(1993). Also, standing reach, height and vertical jump for spike and block were tested according to SMITH et al.(1992). The data was analyzed by descriptive statistics and the ANOVA with repeated measures was utilized to test differences among all groups of data. All the Post Hoc analyses were performed using the Tukey (HSD) follow-up test. The significance level was set at  $p<0,05$ .

The results showed that only agility tests and aerobic power presented means that were statistically significant. The other variables also presented improvements that probably helped in the performance of the team demonstrated during the championship, when Brazil became champion. It is important to notice that most of the results for these athletes were similar to others of this age group at international level (STANGANELLI et al. 2002). This study also showed that evaluating the performance of the players by using a battery of tests could be an important tool to verify how such a young group of Volleyball players adapts to the workloads prescribed during the macrocycle.

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P110-06

**Lower limb functional power development: Olympic weightlifting vs. vertical jump training programs**

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*Keywords: power, vertical jump, weightlifting*

Among sports coaches there is a controversy regarding the best training method to improve lower limbs power. The use of vertical jump (VJ) programs is well established; however, there is a lack of information about the efficiency of Olympic weightlifting (WL) techniques. Its multijoint characteristic associated to the intention to produce maximum power during each movement is considered a WL key feature to promote important neuromuscular adaptations (CANAVAN et al, 1996; YOUNG & BILBY, 1993). However, no study could be found that has submitted non-weightlifters to a period of specific training and analyzed the effects on power and speed during different motor actions. Therefore, the objective of this study was to verify the efficiency of a WL training regimen to improve lower limb power, agility and running speed when compared to a VJ program.

32 young males participated in the study. They were randomly divided in 3 groups: Weightlifting (WL=12), Vertical Jump (VJ=12) and Control (C=8). Before an 8-week training period all subjects were familiarized with training and test procedures. WL training program: 3x6RM high pull, 4x4RM power clean, and 4x4RM clean and jerk. After the first 4 weeks training volume was adjusted to 4x6 RM, 6x4RM, and 6x4RM, respectively. VJ training program: 6x4double-leg hurdle hops, 4x4 alternated single-leg hurdle hops, 4x4 single-leg hurdle hops, and 4x4 40-cm drop jumps. Hurdle height was determined at 125% from CMJ pre-test. After 4 weeks training volume was adjusted to 10x4, 6x4, 6x4, 6x4 jumps, respectively. Additionally both groups performed 4x6RM half-squat. Tests: Pre and posttest were divided in two sessions. First day: SJ and CMJ test, 30 m dash (divided in 10m and 30m segments), and agility test. Second day: half-squat and clean and jerk (only for WL).

ANOVA repeated measures revealed non-significant differences ( $p<0,05$ ) for speed (10m and 30m), agility and CMJ test inter- and intra-groups. Half-squat strength changed significantly from 165,8 to 245,1 for the VJ and from 146,3 to 210,3 for the WL. The WL group also showed greater improvement in the SJ test (9,5% vs. 2,8% for the VJ). There were no significant changes for the C group.

Based on the results it was not possible to identify which training method is more efficient to improve lower limb power, agility and speed. Considering the complex learning process involved in WL techniques the use of VJ programs seems more reasonable.

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## P110-07

**Sprint and jump abilities in soccer players in different positions****Rampinini Ermanno, Sassi Aldo, Impellizzeri Franco**

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*Keywords: soccer, anaerobic power, game positions*

Many authors have investigated the physiological differences in soccer player in various positions. However, the use of different testing protocols to assess anaerobic power make the comparison between studies difficult. To overcome this protocol heterogeneity, comparison of these studies results could be done by a ranking evaluation of 4 position categories (goalkeepers, defenders, midfielders and forwards).

The aim of this study was to evaluate the anaerobic power differences between soccer players in different positions, by elevation expressed in cm, and other parameters, like peak force and power, directly measured on the field with a force platform. Additionally, sprint abilities using a radar system and photocells were assessed to determine differences in sprint characteristics in relation to players positions.

78 soccer players (goalkeepers n=7, defenders n=24, midfielders n=31, and forwards n=16), from amateur to professional level, were tested (mean  $\pm$  SD: age 21.0  $\pm$  4.9 yrs, weight 72.6  $\pm$  5.8 kg). Field tests consisted in 30 m sprint and vertical jumps with hands on hips on a force platform. During sprints, times on 0-15 m, 15-30 m and 0-30 m were measured using photocells. Furthermore, peak speed and speed after 1.5 s and 3 s were measured using a radar system. In vertical jumps absolute and relative to body mass peak power (CMJ-PP) and peak force (CMJ-PF) during concentric phase, and vertical displacement were determined. To compare differences between soccer players with different roles, a one-way ANOVA was used.

No significant differences were found between 4 groups in sprint characteristics. No differences between groups were found except for CMJ-PP in vertical jump parameters.

These results confirmed that goalkeepers were the most powerful athletes, also taking into account the CMJ-PP. Despite the lack of statistically significant differences, they always showed results better in vertical jump parameters using rank classification. On the other hand, in sprint characteristics they were always the worst. This could be explained by the specificity of vertical jump, which is similar to the movements they are used to perform. Midfielders were always less powerful than the other players both in vertical jump and sprint performance. Our results suggest a more discriminant capacity of CMJ-PP compared to the elevation expressed in cm as commonly used.

## P110-08

**Effect of strength gain in low-intensity training****Yona Masae, Kamibayashi Kiyotaka, Muro Masuo**

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*Keywords: strength gain, low intensity exercise, dynamic training*

Generally, the high gain results from stronger workload and longer training period. Low-intensity training causes a little muscle strength increase. Yona (1996) reported that HT-MUs are recruited selectively by skin cold stimulation during low-intensity contraction. Thus even if the training load is low-intensity, strength gain is obtained because many HT-MUs are recruited for repeated contractions. This suggests that it

is possible to obtain a higher effect with low-intensity training using skin cold stimulation. In the present study we examined the effect of strength gain of dynamic training at 35% MVC by skin's cold stimulation on activation muscle.

Subjects were six healthy males. Training in biceps brachii (BB) were performed on both control (TC) and skin cold stimulation (TE). Training was performed with 50 repetitions at 35% MVC target force for 3 sec dynamic contractions at rest for 3 sec at TC, and at TE when the skin cold stimulation was executed for 5 minutes using a cold apparatus. The training period was 6 weeks, data were collected after 3 and after 6 weeks.

After a trained period for 6 weeks, peak force in MVC increased significantly under cold stimulation (19.4 $\pm$ 8.2%) more than in the TC (7.5 $\pm$ 1.7%). In the changes of MVC for 3 weeks, TE also increased more significantly than TC, 15.5 $\pm$ 11.5% and 3.6 $\pm$ 2.3% respectively ( $P<0.05$ ). During repetitive contractions (35% MVC), trial of changes in IEMG clearly increased in the TE more than in the TC. A marked increase in IEMG appeared from onset of about one-third more than under TC training. However, the MPF with repetitive contractions remained clear during 50 repetitions in both TC and TE.

It has been reported that strength gain increases with about 12 weeks of high-intensity dynamic training. The mechanism of muscle gain was the neural and hypertrophy factor. However, the present study showed similar gain using low-intensity training for 6 weeks with cold skin stimulation. It is suggested that IEMG increased during repetitive contractions is related to recruit selectively HT-MUs in TE. The MPF is not changed after 50 repetitions because there was no fatigue in active muscle. These results were due to the light training load. It seems that the strength gain obtained for 6 weeks was increased by neural factors. Thus, these results suggest that low-intensity training by cold skin stimulation is more effective in gaining neural adaptation.

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## P110-09

**The accuracy of the fitness test on Polar heart rate monitors****Mamen Asgeir, Remmen Jorun, Christenson Margit, Sande Hanne Mette**

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*Keywords: training, aerobic capacity, UKK walking test*

Some of the newer models of Polar Heart Rate Monitors (HRM) have a fitness test option, based on the UKK 2 km walk test. To evaluate the accuracy of the test we used 11 females, age 21-57 yr that participated in a fitness program. They randomly performed two walk tests and two VO<sub>2</sub>max tests within 14 days. The walk tests were performed on a level treadmill, with self-adjusted speed; The VO<sub>2</sub>max test on an inclined treadmill. After this testing, a third walk test was performed indoor on a track of artificial grass.

The mean  $\pm$  SD result of the Polar HRM fitness test was about 20% lower than the measured VO<sub>2</sub>max (35.4 $\pm$ 3.5 vs. 43.9  $\pm$  5.8 ml kg<sup>-1</sup> min<sup>-1</sup>,  $p<0.01$ ). The reliability of the fitness test was moderately high ( $r^2<0.60$  and  $S_{xy}=3.15$  ml kg<sup>-1</sup> min<sup>-1</sup>). The standard error of estimate (~9%) in this study is of about the same magnitude as reported elsewhere.

Our results conflicts with others who have found good agreement between measured VO<sub>2</sub>max and both the UKK test and the Polar HRM fitness test. With our sample of physical active female subjects, the Polar HRM fitness test significantly underestimated the real VO<sub>2</sub>max.

## P110-10

**Match analysis of youth soccer matches****Tessitore Antonio, Meeusen Romain, Capranica Laura**

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*Keywords: soccer, children, game analysis*

The aim of youth soccer matches should not be the attainment but represent an evaluation tool for technical abilities. Thus, matches and training should be an integrated system where the field dimensions, the number of players involved in the actions, the co-operation and/or opposition of players, the technical components of the task, and the rules should enhance the development of the children's soccer ability. Since the Italian Soccer Federation (FIGC) organizes 5-a-side championships for 9-year-old children, the aim of the present study was to evaluate the heart rate and technical aspects of official matches played on a 45x25m field.

Twenty 9-year-old children had their heart rates (HR) continuously recorded (5 s) during 5-a-side matches. Grouped frequency distributions of HR values were calculated with a class interval width of 10 beat/min. Video-cameras recorded the occurrence of technical aspects of the competitions: passes, players/action, shots, goals, and corners. Statistically significant differences ( $p < 0.05$ ) between halves and among matches for both the technical aspects and heart rate counts were verified by means of Chi-Square tests.

Subjects showed more frequently HR values higher than 170 beat/min. Regarding the technical aspects, no significant difference was found among subjects or halves. Number of actions ( $44 \pm 6$ ), passes ( $68 \pm 16$ ), shots ( $17 \pm 5$ ), goals ( $2 \pm 1$ ), and corners ( $3 \pm 2$ ) showed no significant difference among matches. Generally, actions were played by two team mates ( $68\% \pm 10\%$ ) and a single pass ( $58\% \pm 12\%$ ) was performed.

To enhance the development of technical aspects of soccer and to meet the physiological demands of children, FIGC organizes youth soccer matches with reduced number of team components and field dimensions. Data showed that soccer matches for young players are high intensity activities suitable for children (Capranica et al 2001). However, the analysis of the technical aspects showed a reduced number of passes and players involved in each action, indicating that the co-operation and ball-contact are not adequately stressed. Furthermore, the limited number of shots and goals in relation to the time played in such a match might not be sufficient. For this reason, it seems reasonable to consider new and more effective forms of youth soccer competitions, which enhance the opportunity of learning soccer abilities.

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## P110-11

**Development of an electronic measuring place in order to optimize boxing training****Salzburger Hannes, Mitterbauer Guenther**

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*Keywords: boxing, training, control of performance*

New findings for the important questions concerning performance relevance in the training practice, development, trainability as well as concerning the influence of tiredness should be reached with the development of a measuring place and the making up of a series of tests specific for boxing (speed and hardness of a punch to optical signals).

An especially developed test device makes it possible to measure the speed of the punch (timekeeping between a given optical signal and the motor answer = striking the punch cushion) and hardness of the punch (measuring the punch energy due to change of the air pressure in the cushion).

Standardized test for the box-specific punch techniques straight to the head, side hook to the head or uppercut to the body, each right and left (chosen reaction to an optical signal via light-emitting diodes).

1: The reliable test shows significant differences when comparing extreme groups (2 performance groups,  $n$  is 16) in the field of speed of action in most kinds of punches, therefore this confirms its performance relevance. 2: The speed of action is longer in technically more demanding kinds of punches (e.g. uppercut). 3: The time factor during the simulated boxing test (5 times, 2 minutes) proves to be rather activating than tiring concerning the speed of action (significant improvement in the last round).

Summarizing you can say that the results we have to hand are an important orientation for optimizing the boxing training. However, the expansion of knowledge (among others trainability, hardness of the punch) is urgently needed.

The device proved to be a very good investment when used for the measuring place training.

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## P110-12

**Relationship between technical skills and game performance in youth basketball players****BrandãoE Eurico, Janeira Manuel, Cura Joao, Cura Pedro**

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*Keywords: basketball, game performance, technical skills*

Performance evaluation is a central problem in the study of team sports. In this context, the possibility of establishing associations between the technical standards and game performance will allow to understand the contribution of the technique for the athlete's performance. This idea was already studied in Basketball senior athletes (Rowe & Boutmans, 1997), but is still unknown for young players. Therefore, the aim of this study was to identify the degree of relationship between technical skills and technical game performance in youth basketball players.

The sample comprises 70 male basketball players aged between 12 and 14 years out of 7 teams of the Aveiro Basketball Association. Technical skills were evaluated according to the AAPHERD Basketball Battery (Kirkendall et al., 1987) and a Technical Circuit proposed by Brandão et al., (1998). Technical game performance was evaluated according to the Game Performance Assessment Instrument - (GPAI), proposed by Oslin et al. (1998) and according to the Game Indicators - (MVP). Pearson Correlation and Simple and Multiple Regression were used as data analysis techniques.

Main results were the following: Simple Regression between Technical Circuit and GPAI ( $n=70$ ,  $r=0.69$ ,  $r^2=48\%$ ,  $SEE=2.83$ ,  $p=0.0001$ ) and Simple Regression between Technical Circuit and MVP ( $n=70$ ,  $r=0.65$ ,  $r^2=42\%$ ,  $SEE=2.80$ ,  $p=0.0001$ ).

Multiple Regression between AAPHERD Basketball Battery and GPAI ( $r^2=61\%$ ) and between AAPHERD Basketball Battery and MVP ( $r^2=57\%$ ).

In conclusion, AAHPERD Basketball Battery showed a better association with game performance, in qualitative (GPAI) and quantitative (MVP) analysis.

This result presents the AAHPERD Basketball Battery as the best game performance predictor at this age group and is well adjusted for pre-selection proposes of youth basketball players.

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Kirkendall, DR et al. (1987). *Measurement and Evaluation for Physical Educators*

Rowe P, Boutmans, J (1997). *A Statistically Based Model for Individual Performance Assessment (IPA) in Basketball*.

#### P110-13

### Analysis of the technical jumps and of the strength and flexibility skills in athletes practising rhythmic gymnastics

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**Keywords:** strength, rhythmic gymnastics, jumps

A sufficient development in the ability of muscle strength, in particular of the lower limbs, is necessary to obtain good results also in technical sports and combinations and the means to increase this strength are very much related to performance. From this consideration it was decided to test the ability of extrinsic strength power during the performance of the most important expressions of this ability: the big jumps and compare them to some of the classical strength tests such as Counter Movement Jump (CMJ) and Stiffness. Eighteen athletes, between the ages of 12 to 15, who do rhythmic gymnastics competitions, were evaluated. They belong to two different technical levels, group B was a young national team and group C was interregional team. Three jumps were analysed for gradual technical difficulty growth and for strength effort which was assumed to keep increasing.

The result of the data showed that there are no significant relations between the performance of the technical jumps and the general strength ability. The result regarding the differences between the three technical jumps analysed by the optojump, confirm technical indications assumed by the sport: the technical difficulty increase leads to a different relationship between the height and the length of the jump caused by an increase of the last step value which lasts longer. It has been confirmed the null hypothesis of the two homogeneity groups.

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#### P110-14

### Resistance to fatigue during elbow-extension depends on triceps brachii muscle fiber type composition

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**Keywords:** fatigue, fibre type, m. triceps brachii

Muscular endurance capacity has been studied extensively and under various external conditions (Saltin and Gollnick 1983). However, most of the research data are related to the lower body musculature. The purpose of the present study was to describe the relationship between resistance to fatigue of the elbow extensors to the fiber type composition of the triceps brachii muscle.

Thirteen male physical education students (age 22yrs, body height 184cm, body weight 85kg), gave their informed consent to participate in the study. They performed an isokinetic fatigue protocol for their dominant elbow extensors. After warming-up, they were positioned on a Cybex II (Lumex Inc., N.Y.) isokinetic device and performed 50 consecutive, maximal elbow extensions at 180°/sec. Fatigue index was calculated as follows: [(average torque of the last three repetitions/average torque of the first three repetitions) x 100]. On a separate day, muscle biopsies from the long head of the dominant triceps brachii were obtained and subsequently analyzed for fiber type composition with ATPase histochemistry.

Mean percentage of type I fiber area was 27.7%, with individual values ranging from 9.2 - 49.2%. Mean Fatigue Index was 43.8%, with individual values ranging from 20.5 - 67.1%. Fatigue Index was significantly related with % type I fiber area ( $r = 0.69$ ,  $P < 0.01$ ).

Results of the present study suggest that the fiber type composition determines approximately half ( $R^2 = 0.48$ ) of the fatigue-resistance capacity of the triceps brachii to a protocol which consists of 50 maximal consecutive concentric contractions performed with a relative fast movement velocity. The higher the percent of type I fibers in triceps brachii the lower was the loss in performance. This phenomenon is most likely linked to the metabolic properties at the single fiber level. The duration (approx. 120sec), and the intensity (maximal), of this test imply that performance relied mostly on the anaerobic glycolysis with a significant contribution of the aerobic energy-production pathway. Type I fibers possess a higher enzymatic capacity for lactate clearance as well as a higher oxidative capacity than type II fibers.

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## P110-15

**Importance of aerobic and anaerobic abilities for results in skill tests in soccer**

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*Keywords: soccer, aerobic performance, anaerobic abilities*

The aim of this study was to investigate the aerobic and anaerobic abilities in soccer and their significance for results in skill and adroitness tests which are commonly carried out in soccer.

33 soccer players which participate in a regular game and training system in junior divisions of a german federal liga team performed an aerobic incremental test on a treadmill, an anaerobic maximum test on a bicycle ergometer (SRM-system - isokinetic, arbitrary maximal) and furthermore a maximal 20 m run, a shuttle sprint, a lattice sprint, several drop jumps, flash jumps and tapping tests. The aerobic and different anaerobic abilities were correlated with the data of the other tests.

All the energetic test data showed no relevant differences between the three age-groups. The average energetic prerequisites were:  $v_{max}$  4,88 m/s,  $v_{anaerobic}$  threshold 3,95 m/s, peak power 13,8 W/kg body weight (BW), alactic capacity 64,7 J/kg BW, and the values for anaerobic capacity 190 J/kg BW, for glycolytic flux 3,35 W/kg BW. Therefore the correlative relations to the motoric tests were calculated by using the data of all 33 players. The aerobic performance did not show a strong relation to the measurements of all motor tests, except for the time of the lattice sprint (3 x 10 m with a break of 2 min). Significantly negative correlations ( $r > 0,40$ ;  $p < 0,01$ ) was found between the anaerobic alactic values of the maximum test at the bicycle ergometer and the times of the 20 m sprint and the shuttle sprint. The anaerobic lactic qualities had only a weak but just significant influence on the time of the shuttle sprint (distance 26 m, 4 changes of direction, test duration 6 to 8 s).

With the exception of the alactic abilities all other energetic prerequisites aren't sufficiently comprehended by the motoric test battery of soccer. To the individual planning of the conditional training, additional tests for the diagnostics of aerobic and also the anaerobic prerequisites are recommended.

**Poster Session****Physiology 4****P11P**

## P11P-01

**Age dependent distribution of skinfold thickness in males**

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*Keywords: skinfold thickness, fat distribution*

The purpose of the study was to determine the difference between skinfold thickness distribution and body composition of men in different age groups.

Total 1231 male subjects aged 14-68 (mean age 31,7  $\pm$  9,4; mean height 178 $\pm$ 6,5; mean weight 81,1  $\pm$  11,3) participated in this study. Skinfold thickness was measured from eight different locations of the body (skinfold caliper 10qms, 0,2 mm sensitive) and fat percent was calculated according to Yuhazs. All the measurements have been taken by the same specialist in the Kinanthropometric Department of the Hillside City Club in Istanbul eight years ago. SPSS programme was used in all statistical analysis. Data were analysed using correlation, mean, standard deviation, minimum and maximum values.

As a result, it has been found that fat percent increased according to ages ( $p < 0,01$ ). Also it has been determined that trunk-exremity ratio increased significantly through the old ages ( $p < 0,01$ ). The abdominal skinfold and the thigh skinfold contained fatty sites compared to trunk and the extremities for all age groups. Also trunk skinfold thickness total was found higher than extremities total's.

## P11P-02

**Effect of circadian rhythm on plantar flexor neuromuscular properties**

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*Keywords: m. triceps surae, circadian rhythm, strength*

It is widely recognized that performance in sport is time-dependent and fluctuates according to circadian rhythms. Concerning muscle strength, it has been shown, more particularly for upper limbs that strength is affected by circadian rhythms (Martin et al, 99; Gauthier et al, 96) and is greater in the evening than in the morning. To the best of our knowledge, no research has previously investigated day-time fluctuations in plantar flexors neuromuscular performance. These muscles, especially the soleus, play a major role in postural function and contain a large proportion of slow type fibres. The aim of the present study was to investigate the possible central or peripheral origin (or both) in the fluctuation of muscular force as a function of the time of day.

Ten healthy male subjects took part in this investigation. They were selected as "neither type" on the basis of their answers to the Horne and Östberg self-assessment questionnaire. They were tested at two different times of day: between 6h00 and 8h00 in the morning and between 17h00 and 19h00 in the evening. These hours were chosen because they correspond to the minimum and the maximum day-time levels of force fluctuations. EMG activities of the plantar flexor muscles were recorded during voluntary and evoked conditions (percutaneous stimulation of the posterior tibial nerve) of strength development.

The force developed during an MVC did not change significantly when tested in the evening (17-19h) as compared with the morning (6-8h). The peak-to-trough difference was -5.7%. All of the other parameters recorded remained constant during the whole day.

Our results indicated that the force of the plantar flexor muscles did not present circadian fluctuation. On the



contrary, most of the studies concerning muscular strength circadian rhythm focused on focal muscles and showed day-time fluctuation of force with an increase during the day. This could be explained by the particular implication of triceps surae muscle in postural activity and daily locomotion.

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#### P11P-03

### Effect of water ingestion during prolonged exercise in a hot-humid environment

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**Keywords:** fluid ingestion, temperature regulation, humidity

Water ingestion during exercise has been reported in improving the thermoregulatory function. The conclusion that hyperthermia was attenuated with fluid ingestion via a higher sweating rate, an increase in skin blood flow (SkBF), a stable blood and plasma volume was based on studies which were carried out in a relatively dry (40%rh) environment. This study determines the effectiveness of fluid ingestion in attenuating hyperthermia during prolonged running exercise in humid environment.

Eight unacclimatised well-trained male runners completed 2 one-hour running exercise at 70% VO<sub>2</sub>max in a hot-humid environment (30.00C, 70.71%rh) with the wind velocity equivalent to the treadmill velocity. The first trial was the non-fluid ingestion trial (NF), followed by the second where water was ingested (FI) to replace 80% of sweat lost from the NF trial. The trials were performed a week apart and subjects were euhydrated prior to the onset of exercise in each trial.

The rise in Tre was not attenuated in the FI trial compared with the NF trial (39.30C ±0.6 vs. 39.50C ±0.4, respectively; P = 0.664). Fluid ingestion produced a significantly higher rate of WBSR compared to when no fluid was ingested (26.1g/min ±5.2 vs. 22.6g/min ±3.6, P = 0.020). However, a higher WBSR in the FI trial did not increase the capacity of E (443.17 W.m-2 ±38.5 vs. 434.20 W.m-2 ±50.3, FI vs. NF, respectively, P = 0.412) which was reflected in the Tsk being not significantly different between the FI and NF trial (32.920C ±0.9 vs. 32.840C ±0.6, respectively; P = 0.658). The capacity to transfer heat via K was also unaffected by fluid ingestion during exercise (148.78 W.m-2 ±21.7 vs. 140.18 W.m-2 ±20.7, FI vs. NF, respectively, P = 0.150). An important finding of this investigation was that there was no evidence to suggest a decline in WBSR or hidromeiosis during high-intensity exercise in humid environment. Clearly the central drive for sweating was greater than any inhibitory effect on the rise in Tre.

This observation indicates that fluid ingestion does not enhance heat dissipation under humid environmental conditions with additional sweat produced dripping from the skin surface rather than contributing to evaporative heat loss as previously reported. There was also no increase in K (indicative of an increase in SkBF) when fluid was ingested which is consistent with the understanding that a plateau in SkBF with no additional increase will occur when Tre is around 38.0C.

#### P11P-04

### Effects of sock type on foot skin temperature and thermal demand during exercise

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**Keywords:** running, thermoregulation, socks

Increases in temperature during exercise can be uncomfortable and detrimental to performance. Technical fabrics have been developed but footwear have received little attention despite the fact that the thermal state of the feet may alter core temperature. This study examines foot skin temperature, thermoregulatory factors and energy expenditure when running in two different types of running sock.

8 healthy males and 8 healthy females visited the laboratory on 2 occasions, 1 week apart, at the same time of day. Prior activity, fuel and fluid intake were standardised and temperature and humidity carefully controlled during testing. Athletes ran on a treadmill at 12 km.h-1 for 30 min following a 3 min warm-up at 10 km.h-1. The same running shoes and clothing were worn on both visits but participants wore ergonomic socks on one visit and standard socks on the other. Participants, socks and shoes were weighed before and after each run to calculate sweat loss and accumulation. Thermistors measured core, weighted skin and foot temperature throughout. Heart rate and thermal perception were also measured. On completion of both trials, athletes completed a questionnaire about the socks. Mean and standard deviations of all data were calculated and difference tests performed (two-way two-factor ANOVA or Paired t-Tests).

Mean heart rate was the same wearing both pair of socks and although core, mean skin and foot skin temperature were not different between conditions, temperatures were slightly higher when wearing the ergonomic socks. Sweat rates were calculated as 1.0 ± 0.5 kg.h-1 and 1.2 ± 1.1 kg.h-1 for the ergonomic and standard socks respectively (P > 0.05). Both socks retained similar amounts of sweat but more sweat was retained by the shoe when wearing the ergonomic sock. Thermal perceptions for each sock were not significantly different but ergonomic socks tended to evoke a slightly lower rating. 63% of athletes were more likely to buy the ergonomic socks.

Type of sock worn does not have a significant influence on physiological, metabolic or thermoregulatory responses to running. Increases in skin temperature tend to cause increases in sweat rate, but ergonomic socks may have transported sweat away from the skin before it was able to cool the skin surface. Despite this, the ergonomic sock was perceived to be cooler and was the preferred sock. Subjective perceptions may be more important than objective measurements when selecting a sock for wear during prolonged exercise.

#### P11P-05

### Relationship between metabolic and nervous system characteristics in football players

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**Keywords:** anticipation, concentration, metabolic characteristics

The stereotyped opinions of coaches include that the athletes' physical fitness also guarantees his mental fitness. The present study served as a preliminary investigation to

determine the extent to which mental fitness and physical fitness are related.

The subjects were 42 male football players of the best football club in Estonia (FC Flora). The average age was  $21.8 \pm 3.78$  years, height  $180.7 \pm 7.24$  cm, body mass  $76.5 \pm 8.40$  kg. Each athlete has been tested at least 2 times a year during the last 4 years. The test battery included incremental treadmill test to volitional exhaustion. Blood lactate concentration (Bla), maximum oxygen uptake (VO<sub>2</sub>max), and heart rate (HR) at anaerobic threshold were recorded. Anticipation speed and correctness, and ability to concentrate were assessed using the software "WinPsycho 2000" (Thomson 2001). From all tests a given athlete underwent, 4 tests were selected in which he had the highest maximum oxygen uptake, the highest anaerobic threshold, the lowest maximum oxygen uptake and the lowest anaerobic threshold. For those 4 tests, the mean values of the indices and the t-test and Pearson product moment correlation coefficients were calculated.

The mean value of the highest VO<sub>2</sub>max was  $58.3 \pm 4.47$  ml.kg<sup>-1</sup>.min<sup>-1</sup> and the mean value of the lowest VO<sub>2</sub>max was  $52.7 \pm 4.13$  ml.kg<sup>-1</sup>.min<sup>-1</sup>. The mean value of the highest HR at the anaerobic threshold was  $181.7 \pm 6.58$  beats.min<sup>-1</sup> and the mean value of the lowest HR by lactate-4 was  $172.8 \pm 7.58$  beats.min<sup>-1</sup>. The mean values of maximum and minimum anticipation speed were  $0.560 \pm 0.078$  s and  $0.600 \pm 0.070$  s and the means of ability to concentrate were  $0.206 \pm 0.031$  s and  $0.232 \pm 0.040$  s). All means differed significantly ( $p < 0.05$ ). None of the 4 metabolic indices had any remarkable correlation with the indices of the nervous system.

The aerobic and anaerobic metabolic characteristics seem to impact the characteristics of the nervous system differently but there is no remarkable correlation between the values of those indices. The highest values of metabolic indices don't bring along the highest values of the indices of the nervous system. One-sidedness in training, giving the highest values of the aerobic or the anaerobic indices, mostly deteriorates the indices of the nervous system.

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#### P11P-06

### Faster oxygen uptake kinetics at the onset of submaximal cycling exercise following 4-weeks of recombinant human erythropoietin (r-HuEPO) treatment

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**Keywords:** oxygen kinetics, oxidative metabolism, erythropoietin

We undertook this study to determine whether prolonged moderate doses of recombinant human erythropoietin (r-HuEPO) would significantly alter the dynamic response of pulmonary O<sub>2</sub> uptake (VO<sub>2</sub>) at the onset of moderate-intensity exercise.

Sixteen endurance-trained athletes were divided into two groups: r-HuEPO ( $n = 9$ ) and placebo ( $n = 7$ ). During the 4-weeks study, r-HuEPO or saline injections were given three times a week. Exercise testing comprise before and after the 4 weeks incremental maximal tests and several transitions of 10-min period from unloaded cycling to 65% of maximal VO<sub>2</sub>. VO<sub>2</sub> kinetics was determined breath-by-breath at rest and during the submaximal bouts.

In the r-HuEPO group, hemoglobin concentration and hematocrit values at rest and both maximal VO<sub>2</sub> and power

output increased significantly ( $P < 0.05$ ) after the 4 weeks, whereas no changes were observed in the control group. The time constant of the primary VO<sub>2</sub> response was significantly faster after compared to before the 4 weeks in the r-HuEPO group (means  $\pm$  SE;  $29.3 \pm 1.5$  vs.  $35.7 \pm 2.8$  s, respectively,  $P < 0.05$ ) but was unaffected in the placebo group ( $34.5 \pm 2.8$  vs  $33.4 \pm 3.0$  s). Collectively, our findings suggest that r-HuEPO contributes to an improved O<sub>2</sub> delivery to muscles and may induce speeding in the initial rate of oxidative phosphorylation.

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#### P11P-07

### Superior mesenteric artery blood flow during static exercise and postexercise muscle ischemia

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**Keywords:** heart rate, blood pressure, splanchnic circulation

In exercising muscle, interstitial metabolites accumulate and stimulate muscle afferents. This evokes the muscle metaboreflex and raises arterial blood pressure. The increase in arterial blood pressure due to the muscle metaboreflex is mediated via a rise in peripheral vasoconstriction such as in splanchnic vascular beds. However, it has not yet been investigated whether the superior mesenteric artery (SMA), one of important arteries in splanchnic organs, is affected by the muscle metaboreflex.

We, therefore, investigated the blood flow in SMA during static handgrip exercise and its postexercise muscle ischemia. <Methods> Ten healthy volunteers performed sustained static handgrip exercise at 30 % of maximum voluntary contraction for 2 min followed by a 6-min recovery period (control experiment). The subjects also joined the ischemic experiment in which a 3-min arterial occlusion period was applied during recovery to the exercised forearm muscles by an upper arm cuff (occlusion experiment). Subjects had to fast for 12 hours before all experiments. Mean arterial blood pressure (MAP, Finapres method), heart rate (HR, ECG recordings), and the blood flow in SMA (SMABF, Doppler ultrasound technique) were measured during the control and occlusion experiments.

The MAP and HR increased significantly during static exercise and these increments were similar between control and occlusion experiments. After exercise, MAP in the occlusion experiment sustained a higher level while HR had fully recovered. During static handgrip exercise, SMABF in the control and occlusion experiments was unchanged from the resting levels. In contrast, the SMABF during occlusion was significantly higher in the occlusion experiment than that in the control experiment. <Conclusions> The unchanged SMABF during exercise showed that the SMA did not play an important role in the significant increase in MAP during static exercise. The abundant increase in SMABF during postexercise ischemia was probably induced by the buffering effect via arterial baroreflex, suggesting that the SMA was more sensitive to the arterial baroreflex rather than the muscle metaboreflex.

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## P11P-08

**An acute bout of endurance exercise results in alterations in sub-cellular localization of key regulators of translation initiation**

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**Keywords:** exercise, metabolism, protein

In this study we investigated the subcellular localization of some of the proposed key factors in translational control and their response to endurance exercise.

Ten endurance-trained male athletes performed a 2h exercise trail at a 55% Wmax workload. Before, immediately after and after 2h of recovery, muscle biopsies were obtained. Intracellular and nuclear p70S6K, S6 and mTOR content were determined using quantitative immunofluorescence microscopy on muscle cross-sections.

Exercise results in a strong increase in the amount of activated S6, mTOR and S6K1 in the nuclei ( $P < 0.05$ ), whereas intracellular S6 increased slightly. After 2h of recovery intracellular phospho S6 and phospho-mTOR were further increased whereas nuclear S6 returned to baseline values. Nuclear phospho-S6K1 and phospho-mTOR remained elevated throughout the recovery period ( $P < 0.05$ ).

This study clearly shows that endurance exercise results in an alteration of subcellular localization of different proteins that control the rate of translation initiation. Furthermore, this study demonstrates that immunohisto-chemistry provides us with effective tools to investigate the translational control.

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## P11P-09

**Reevaluation of myofibrillar ultrastructural alterations in human muscles with DOMS**

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**Keywords:** eccentric exercise, muscle damage, myofibrillar remodeling

Myofibrillar ultrastructural damages are associated with DOMS induced by eccentric exercise. The damage is usually referred to as any disturbances of the myofiber cross-striated band pattern, which typically is seen as Z-disc streaming, broadening and even total disruption. It is well known that myofibrillar Z-discs are composed of many different proteins and so far our knowledge as how these proteins are affected is rare. Therefore the previous interpretation that the myofibrillar alterations represent damage is still questionable. In the present study, human muscle biopsies taken at different times after a bout of eccentric exercise were analyzed with transmission electron microscopy. Our aim is to compare the ultrastructural changes with our previous observations obtained from the same biopsies but analyzed with different antibodies against desmin, alpha-actinin, titin Z1 and nebulin (NB2) and with phalloidin which stained F-actin.

Major changes were only observed in biopsies taken 2-3 days and 7-8 days post exercise, which were classified into four types according to their different appearances. 1) Broad Z-disc where the Z-discs were irregular and amorphous and showed decreased electron density. 2) Bisect Z-disc which appeared as doubled with two dense lines connected with material of higher density than the I-band but lower than the

Z-disc. 3) Sarcomere disruption which showed lack of dense Z-discs and lack of one or more well-defined A-bands. 4) Supernumerous sarcomeres and nonius periods where the sarcomeres contained longitudinal strands of electron dense material which spanned one or several sarcomeres.

The broad Z-disc was believed to reflect the broad F-actin bands where alpha-actinin, titin Z1 epitope and nebulin NB2 epitope were absent. When the three proteins re-appeared on both sides of the broad F-actin bands, they were comparable to the bisect Z-discs. In the areas of sarcomere disruption, since both the Z-discs and the A-bands were indistinguishable, we believe that Z-disc protein alpha-actinin, Z-disc epitope titin and I band epitope nebulin were absent from the areas. The amorphous material might contain the F-actin longitudinal strands. Finally, both methods revealed supernumerous sarcomeres and nonius periods where the alpha-actinin, titin Z1 and nebulin NB2 re-appeared together with increased F-actin filaments. Our conclusions were that the ultrastructural alterations did reflect changes in the myofibril proteins content and organization. These changes all together reflect a myofibrillar remodeling due to the eccentric exercise.

## P11P-10

**Anaerobic capacity for legs and arms in elite male and female athletes**

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**Keywords:** power output, Wingate test, anaerobic

The 30-s Wingate anaerobic test (WAnT) is by far the most popular test of anaerobic performance, however there is some controversy over the resistance load used for the leg test, and mainly for the Wingate anaerobic arm test (WAnAT). The breaking force originally suggested for untrained population (i.e. 0.73 N per kg of body mass) is still used by many researchers in the evaluation of trained athletes, however it seems relatively low. The evidence derived e.g. from the force-velocity tests had shown that in trained males the optimal resistance for legs may attain approximately 1.0 N.kg<sup>-1</sup>, and in female athletes 0.84 N.kg<sup>-1</sup>. For the WAnAT, the optimal resistance load is unknown, in general, a level of 60 to 65 % of leg value is recommended. The aim of the study was to reveal the anaerobic performance data in elite male and female athletic populations, using the resistance loads 1.02 and 0.84 N.kg<sup>-1</sup>, for legs and 0.68 and 0.56 N.kg<sup>-1</sup> for arms (i.e. 2/3 leg value), in males and females, respectively.

Two groups of athletes were investigated in the study. First group, 90 male and 33 female athletes trained for lower body (e.g. swimmers, skiers, bikers, ice hockey players and taekwon-do athletes) performed two lower body tests: a maximum aerobic test and an anaerobic one (WAnT). The second group, 71 male and 39 female athletes trained for upper body (canoe and kayak paddlers), performed two upper body exercise tests: maximum aerobic arm ergometry and a 30-s WAnAT.

In males, peak power output (PP) and mean power output (MP) in WAnT were 14.1 (1.2, S.D.) and 11.1 (0.9) W.kg<sup>-1</sup>, and in WAnAT 9.8 (1.3) and 7.4 (1.0) W.kg<sup>-1</sup>, respectively. In females, the values attained 10.3 (0.8), 8.5 (0.6) W.kg<sup>-1</sup>, and 6.7 (0.9) and 5.3 (0.7) W.kg<sup>-1</sup>, respectively.

PP and MP values from this study are 20 to 25 % higher than previously reported data or norms for highly trained male and female populations (Inbar et al. 1996, Maud and Schultz, 1989) that corresponds to the differences in the resistance

load used in this study and in former studies (e.g. 0.73 N.kg<sup>-1</sup> for WAnT). These results indicate that traditional low resistance loads when used inadequately in trained populations may roughly underestimate both their lower and upper body anaerobic performance.

#### P11P-11

### Hypoxia attenuates glucose response of athletes in subsequent glucose tolerance test in normoxia

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**Keywords:** *training, carbohydrate metabolism, altitude*

In addition to insulin, muscle contractions and hypoxia are the major stimuli to glucose transport in the skeletal muscle. Therefore, we studied the effects of acute and chronic exposure to normobaric hypoxia on the results of oral glucose tolerance test (OGTT) in subsequent normoxia.

The subjects were 20 trained endurance athletes (age 24±4 years, BMI 22±1, VO<sub>2</sub>max 71±3 ml/kg/min). In the acute cross-over overnight hypoxia study (n=8) the athletes were randomised (single-blind) either to hypoxic or normoxic exposure for the first 12-h night. In the morning, the subjects moved to a normoxic room where, after a 30-min rest, an OGTT with glucose load of 75 g was done. Blood samples were drawn before and after 30, 60 and 120 min of glucose ingestion. In the chronic hypoxia study (HiLo, n=12) the athletes slept and stayed 12h daily for two weeks in a normobaric hypoxic room but carried out their normal living and training schedules at sea level in ambient normoxia. After the last night in hypoxia, an OGTT was done in normoxia as described above. Plasma glucose and serum insulin concentration were analysed and the area under the curve (AUC) as well as the insulin sensitivity (IS<sub>Iest</sub>) were calculated from the OGTT-data and demographic parameters.

Acute overnight hypoxia did not influence glucose and insulin concentrations in the OGTT. However, IS<sub>Iest</sub> was higher after overnight hypoxia as compared with overnight normoxia. After 2-week HiLo, fasting glucose and insulin were not altered when compared with values before the exposure but AUC for glucose was decreased ( $p<0.05$ ) and the IS<sub>Iest</sub> was increased by 20% ( $0.18 \pm 0.01$  vs.  $0.22 \pm 0.01$ ,  $p<0.01$ ).

Hypoxia stimulated glucose disposal and enhanced insulin sensitivity in endurance athletes who are known to have improved glucose tolerance. The results support observations that hypoxia can stimulate glucose disposal independent of muscle contraction. This mechanism lasts at least 2-3 hours after moving from hypoxia to normoxia.

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#### P11P-12

### Influence of different temperature in human tendon structures on viscoelastic properties

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**Keywords:** *stiffness, temperature, tendon structures*

Walker et al. (1976) reported that it was decrease in young's modulus according to depend upon ambient temperature using a dog's tendon. However, previous studies have been shown little evidence about the relationship between ambient temperature and the elongation of the tendon in human. Recently, new idea in terms of behavior of fascicle length, pennation angles and elastic component during the isometric contraction in human has been observed by ultrasonography. The purpose of this study was to investigate the influence of tendon structures of medial gastrocnemius muscle (MG) on difference temperature in human by used by ultrasonography. Five male subjects volunteered to participate in this experiment [age: 21.0±3.0years, height: 171.5±6.1cm, weight: 69.2±5.8kg]. The elongation of the tendon and aponeurosis of MG during isometric contraction plantar flexion was determined by real time ultrasonography. The subjects performed with ramp isometric contraction plantar flexion up to the maximum voluntary contraction (MVC), following a ramp relaxation. The relationship between the estimated muscle force (F) of plantar flexion of MG and tendon elongation (dL) during the ascending phase was fitted to a linear regression, the slope of which was defined as stiffness of the tendon structures. It was three conditions of measurement, control condition (non immersion), hot water condition (45°C) and cold water condition (10°C).

The relationship between F and dL was curvilinear and consisted of an initial region, characterized by a large increase in dL with increasing F, immediately followed by a linear region. The maximal F and stiffness in cold condition were significantly higher to compare with control condition. In the all conditions, there was no significant change in the maximal elongation of aponeurosis of MG. These results suggest that the stiffness in aponeurosis of MG increases in cold condition.

#### P11P-13

### Intramuscular triacylglycerol turnover in resting human skeletal muscle

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**Keywords:** *muscle, intramuscular triacylglycerol, fatty acids*

The present study was undertaken to investigate fatty acids and triacylglycerol turnover in human resting skeletal muscle in subjects resting in supine position for ten hours. Due to the relatively high mTAG turnover rate, when using stable isotopes to measure mTAG synthesis rate, the possibility exists that the label incorporated in mTAG is not definitively lost in this pool, and therefore might reappear. This would result in an underestimation of the mTAG fractional synthetic rate (FSR). In order to verify this possibility we have studied two consecutive 4-hour periods.

Six healthy subjects were studied during 10 hours of rest. Leg palmitate kinetics was studied by means of the tracer dilution method (constant infusion of [U-13C]-palmitate) and the arterial-femoral venous difference technique. Muscle biopsies

were taken from the vastus-lateralis muscle after 2,6, and 10 hours of rest for the measurement of intramuscular non-esterified palmitate and TAG-palmitate concentration and enrichment in order to measure the rate of plasma palmitate incorporation into mTAG.

The mTAG FSR was 3.4%/h and in line with what previously reported in inactive skeletal muscle (Sacchetti et al, 2002). mTAG FSR during the two 4-hour periods (2-6h and 6-10h) was not significantly different. About 60% of the fatty acid taken up from the circulation were directed toward esterification in mTAG, whereas 30 to 40% were oxidized. mTAG concentration did not change significantly during the study period.

The stable mTAG concentration over the 10h period of the study indicates that the relatively high synthesis rate is balanced by an equally high rate of breakdown, therefore suggesting that mTAG turnover in resting human skeletal muscle is a relatively fast process (about 29 hours). Despite this high turnover rate, the stable FSR over the two 4-hour periods indicates that reappearing of the label from mTAG pool during the time period of the present study is unlikely. Finally, a substantial proportion (~60%) of the fatty acids entering resting skeletal muscle from the circulation is stored in mTAG.

Sacchetti M., B. Saltin, T. Osada, G. van Hall. *J. Physiol.* 540(1): 388-395, 2002.

#### P11P-14

### Dyhydropyridine usage improves functional recovery after ischemic stroke

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*Keywords: rehabilitation, stroke, physical therapy*

Functional recovery after cerebral infarction is a complex phenomenon that depends on various factors. An objective

of therapeutic intervention after cerebral ischemia is to promote improved functional outcome of the patients. This improved outcome may be associated with a reduction of the volume of the cerebral infarction and the promotion of cerebral plasticity. There are several drugs, able to promote or oppose such recovery. We wanted to investigate if the Dyhydropyridine calcium blockers are among them.

Our investigation was performed on 90 patients after ischemic stroke, underwent the neurological and than the rehabilitation treatment. Investigation was carried out at the Clinical Center of Novi Sad, Clinic for Medical Rehabilitation. Two groups of patients after ischemic stroke were made: first group with patients who in therapy had Dyhydropyridine calcium blockers and group of patients treated by other medicaments. Barthel index score was the instrument used for the functional recovery evaluation. Barthel's measurements were obtained at first week and at discharge.

Average length of rehabilitation treatment for patients of both groups was about 6 weeks. The median Barthel score at first week increased for 31,74% in patients which used Dyhydropyridine calcium blockers during the rehabilitation treatment, while in control group median Barthel score increased just for 20,19%.

There is much experimental evidence, which supports a major role of increased intracellular calcium levels in the induction of neuronal damage during cerebral ischemia. Also, experimental data confirm that Dyhydropyridine significantly reduces the membrane depolarization and the intracellular calcium elevation. There were no differences in length of the rehabilitation treatment in both groups in the ischemic stroke patients. But, the functional recovery, measured by Barthel index was significantly better in patients group, treated with Dyhydropyridine.

So we can conclude that Dyhydropyridine calcium blockers promote plasticity of the nervous system and also have neuroprotective characteristics.

## Poster Session

### Physiology 5

### P11Q

#### P11Q-01

### Relationship between body composition and resting energy expenditure in athletes

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*Keywords: body composition, REE, LTM*

The purpose of this study was to observe the relationship between free lean tissue mass (LTM) and resting energy expenditure (REE) in whole body and regional part for throwers, sprinters and distance runners in track and field.

The subjects were 59 male college athletes (20 throwers, 20 sprinters and 19 distance runners). Their mean age was 20.3±1.6 years. The body composition measurement was used with Dual Energy X-ray absorptiometry (DXA method: XR-26 Norland co. USA). REE measurement was used with respiratory analyzer by Meta vine (Vine co. Japan). Further REE was measured in the controlled climate chamber. The value of REE was determined by 5 min. after 10 min. resting using the expiration mask. Analysis used the unpaired t-test

comparison among events, and the correlation coefficient between LTM and REE.

The result of this research, the REE per weight was observed significant different among the athletic events ( $p < 0.05$ ). The REE was closely related to the LTM in whole body ( $p < 0.001$ ). The other side, the REE per LTM value were not significant different for all events.

From these results, it was considered that the REE influenced the muscle volume more than athletic training mode in track and field.

Morrison JA et al(1996) *Journal of Pediatrics*, 129: 637-642. Muller MJ et al(2001), *Eur. J. Nutr* 40 : 93-97. Hosoya N et al (2002) *Clinical and Experimental Pharmacology and Physiology* 29: 16-18.

## P11Q-02

**Wingate Anaerobic Test in the assessment of explosive power**

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*Keywords: anaerobic capacity, explosive power, Wingate test*

The analysis of human anaerobic performance can be obtained on the basis of values of Wingate Anaerobic Test (WAnT). While there is not enough information to determine whether any anaerobic test is superior to others, Wingate test is considered as "the most tested test". Wingate can give us information about peak power (PP) - expressed as the highest power output averaged over 5s period and anaerobic capacity (AC) as the work performed during the test. With the improvement of our counting and recording programs we are able to measure the increase in power in every second instead of 5 second interval (pedaling speed used to be monitored every 3-5 s). This parameter reflects explosive power, and informs us about the velocity one reaches peak values of power from the beginning of the test.

All parameters of anaerobic capacity were investigated in 75 subjects classed into different groups depending on their physical fitness and sport specialities. The analysed groups consisted of football players (n=21), volleyball players (n=13), rowers (n=11) and non sportsmen (n=30).

The results were compared considering the type of sport (aerobic, anaerobic). The results indicate that the highest values of all parameters were registered in the group of volleyball players. That could be explained by the fact that this sport is considered to be mostly anaerobic. Explosiveness, a new parameter obtained by WAnT, also shows the highest values in this group, as expected.

This new parameter obtained by Wingate test can be implemented in further investigations in the field of anaerobic capacity, as well as in following the training programs. The ultimate potential for explosive movements are determined by the fast twitch composition of muscles, and probably by the nature of the ATPase secreted by the respective fibers' cross bridges.

## P11Q-03

**Cardiorespiratory and metabolic responses during a dry-land board paddling exercise in two groups of competitive surfers**

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*Keywords: aerobic fitness, surfing, board paddling exercise*

High performance in surfboard riding (surfing) demands a great variety of fitness requirements due to the different tasks nature that surfers have to perform while surfing. Board arm paddling (lying in a prone position), usually represents the most time demanding activity during surfing practice. The purpose of this study was to evaluate and compare the upper body aerobic fitness characteristics in two groups of competitive surfers with different performance levels.

Thirteen highly trained competitive surfers participated in this study. Subjects performed a simulated surfboard arm paddling exercise, lying in a prone position, on a modified kayak ergometer. The surfers were divided in two groups; seven of the surfers were European level surfers (ELS) and the other six were regional level surfers (RLS). A continuous

incremental exercise test was performed to determine peak oxygen uptake (VO<sub>2peak</sub>), peak power output (W<sub>peak</sub>) and the exercise intensity that elicits a blood lactate concentration of 4 mmol·l<sup>-1</sup> (LT<sub>4</sub>). An independent Student's t-test was used to determine the significant differences between the physiological characteristics of the two groups.

Significant difference was found in LT<sub>4</sub> (P = 0.02) between ELS and RLS. LT<sub>4</sub> was reached at an exercise intensity of 95.18 ± 3.42% VO<sub>2peak</sub> in ELS, whereas in RLS it occurred at 88.89 ± 5.01% VO<sub>2peak</sub>. W<sub>peak</sub> was also significantly higher (P = 0.04) in ELS than in RLS (154.71 ± 36.82 W vs. 117.70 ± 27.14 W). No significant differences were found for VO<sub>2peak</sub>, HR<sub>max</sub> and [lac]<sup>-</sup> (peak) between the two groups. W<sub>peak</sub> and LT<sub>4</sub> have been previously reported to be more sensitive indicators of endurance performance than VO<sub>2max</sub>. Moreover, the literature suggests that endurance fitness is an important physiological determinant of performance during high intensity intermittent exercise, by means of enhancing the recovery processes. Due to the intermittent nature of board paddling exercise, this study suggests that competitive surfers develop specific physiological adaptations that should not be underestimated.

## P11Q-04

**An acute bout of aerobic exercise does not alter resting energy expenditure in healthy young women**

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*Keywords: resting energy expenditure, aerobic exercise, fat oxidation*

The purpose of this study was to examine the effects of an acute bout of aerobic exercise on REE and fat oxidation (measured by the respiratory quotient, RQ) in healthy young women.

Eight young females volunteered to participate in this study. Participants did not exercise three days prior to the first REE measurement and participated in two different conditions. One condition in which they ran for 60 minutes at an intensity corresponding to 70-75% of their maximal oxygen consumption (VO<sub>2max</sub>) and a condition in which they did not exercise. REE was measured for 40 minutes by the open-circuit dilution method using a metabolic cart (Vmax29, Sormedics, USA) that was calibrated before each test using standard gases of known concentration. Ten, 24 and 48 hours post-exercise participants were transferred to the lab where the same as above procedures were followed for the assessment of the REE. Repeated measures analyses of variance were performed for each condition to test for differences in REE and RQ across time.

Regarding REE the analysis indicated that there were no significant differences across time for the control and the exercise conditions (F(3,5) = 2.43, p = .18 and F(3,5) = 1.08, p = .44, respectively). Regarding RQ, the analysis for the control condition indicated that there were no differences across time (F(3,5) = 0.57, p = .66), whereas for the exercise condition significant differences were revealed (F(3,5) = 9.49, p < .05). Post-hoc planned contrasts indicated that significant differences existed between the pre-exercise measurement and the 10-hours and 24-hours post exercise measurements (F(1,7) = 5.93, p < .05 and F(1,7) = 22.77, p < .01, respectively).

Therefore, these results indicate that an acute bout of exercise does not alter the resting caloric expenditure but increases fat oxidation up to 24 hours post-exercise.

#### P11Q-05

### Heart rate variability and respiratory changes with Astaxanthin ingestion during three stepwise exercises

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*Keywords: heart rate variability, astaxanthin, respiration*

This study was designed to evaluate the effects of astaxanthin (AST) ingestion on activities of the autonomic nervous system (ANS), and anti-fatigue, that has been changed with the food supplement and exercise load. With the ingestion of AST, sympathetic nervous activity (SNA) and respiratory function have reported to be facilitated in order to promote the motor ability, while vagal activity (VNA) has been inhibited during exercise. Objective of this experiment was to collect data of the balance of ANS and respiratory metabolism with AST beverage.

Nineteen healthy volunteers were randomized into two groups. Group AST (10 subjects) received one astaxanthin capsule (5mg) daily for two weeks, while Group CON (9 subjects) ingested oral a placebo capsule with the double blind method. After a month from this ingestion, other capsules were taken again with cross-over system for the same subjects, respectively. All subjects participated to three stepwise intensities of 30%, 50%, and 70%Maximum Heart Rate (HRmax)) at four times. R-R intervals of the ECG (CM5 lead) and expired gas(Breath By Breath method) recorded to analyze at Heart Rate Variability (HRV) and at VO<sub>2</sub>, VCO<sub>2</sub>, and VE each intensity of those exercise. HRV were processed to the power spectrum by using modified Maximum Entropy Method (MEMCalc), and those spectra were divided into three frequency bands such as the total frequency bands (0.02~0.5Hz, TF), the low frequency bands (0.02~0.15Hz, LF), and the high frequency bands (0.15~0.5Hz, HF). Furthermore, LF/HF ratio (AU) were corresponded to SNA, and HF/TF (%) were estimated with VNA, quantitatively.

Comparative detection was evaluated with effectiveness of AST ingestion upon changing values between two groups. Significant difference between AST and CON were obtained as increase of respiratory-circulatory (VO<sub>2</sub>/kg, VE, HR, and systolic blood pressure) during exercise from expired gases analysis. Additionally, promotion of SNA (LF/HF ratio) during exercise and VNA (HF/TF%) during recovery were observed as significant increasing data.

Findings of the present study indicated that ingestion of AST capsule augmented respiratory-circulation ability and activity of SNA during exercise. Therefore, the motor performance should be increased to make superior energy metabolism during exercise load. That anti-fatigue effectiveness with AST supply might be promoted for human to make recovery ability from the whole fatigue elicited by exercise stress.

#### P11Q-06

### Blood lactate concentration of elite alpine ski racers during training camps at moderate altitude

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*Keywords: alpine skiing, blood lactate, moderate altitude*

Blood lactate concentration is known to be influential on performance. At moderate altitude exercise causes higher blood lactate production and reduced blood lactate elimination when compared to sea level conditions. The type of recovery between runs, however, could modify lactate kinetics. Therefore, the aim of this study was to examine blood lactate concentration in elite alpine skiers during training camps at moderate altitude depending on different types of recovery.

Before the beginning of the training arterial blood lactate levels of 16 male athletes were measured at an altitude of 2400 m. The team was separated into two groups: one group (G1) performed exercise at a moderate intensity between runs (= active recovery) and the other (G2) recovered passively. Blood lactate concentrations were measured 1, 10 and 15 minutes after the fourth and eighth training run.

Blood lactate concentrations at rest were 2.6 ( $\pm$  0.48 mmol/l; SD) for G2 and 2.3 ( $\pm$  0.30 mmol/l) for G1. At the end of the training with 15 min periods of moderate active recovery between runs blood lactate concentration was clearly lower ( $2.6 \pm 0.41$  mmol/l) when compared to passive recovery ( $4.6 \pm 1.34$  mmol/l).

Moderate active recovery (heart rate = aerobic threshold) after competitive training lowers the blood lactate concentration which is known to be combined with higher subsequent performance. The higher level of muscle blood flow and cell metabolism during active recovery might allow for a greater lactate removal - also at moderate altitude.

#### P11Q-07

### The effects of a heat exchange mask on shooting performance in the cold

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*Keywords: shooting, heat exchange mask*

It has been well established that inhalation of, and exposure to, cold air leads to drastic changes in physiological function. Wearing a protective mask during cold exposure has been shown to be effective in reducing physiological stress and improving performance. As finger temperature decreases, so does finger dexterity too. Changes in finger temperature, as well as a loss in dexterity, may have a profound impact on shooting performance. The purpose of this study was to assess the influence of a heat exchange mask on shooting performance in the cold.

Seven experienced rifle marksmen volunteered to participate. On the first day of testing, half of the subjects wore a heat exchange mask (HE, Polarwrap, Inc., Memphis, TN) while the other half did not wear the heat exchange mask (NM). Treatments were switched on the second testing day. Target distance was 25 m. Each interval consisted of firing three rounds each in the seated and standing positions. Following baseline measures, subjects rested quietly for 60 minutes at -8 C ( $\pm$ 2 C) and then repeated the shooting protocol. Shooting was scored for points (absolute scoring) and for shooting precision. Shooting precision was assessed by calculating the area of the triangle from the three rounds.

Shooters required an additional  $28.9 \pm 4.5$  seconds to complete their six round interval during the NM treatment compared to the HE treatment. No statistical differences were observed between HE and NM treatments for absolute shooting scores from pre- to post-exposure. Precision scores, however, were significantly increased by 30% in the sitting and standing positions during the NM treatment. Precision scores were maintained at baseline levels in the HE treatment following cold exposure. Heart rate was maintained at baseline level during the HE treatment, but decreased by 11 bpm during the NM treatment.

When exposed to  $-8^{\circ}\text{C}$  temperatures, perceived cold and heart rate responses were attenuated by the use of a heat exchange mask. While absolute shooting scores did not differ between HE and NM, precision of a three shot group during the sitting and standing shooting positions were maintained when HE was worn, but were significantly increased in NM. Lastly, subjects were able to complete their six shots 29 seconds faster with HE than NM. These results indicate precision and physiological benefits of the HE to those shooters who have to perform in cold temperatures.

#### P11Q-08

### Post-competition blood lactate in elderly alpine skiers

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*Keywords: lactate, alpine skiing, elderly*

The contributions of energy sources in alpine skiing (giant slalom) are about 50% aerobic, 25% lactic and 25% alactic. In the elderly the functional capacity is lower and probably the contribution of the energy sources to some sport performances is modified with age.

The aim of this paper was to study the relationship between age and blood lactate accumulation after a giant slalom competition (1,250 m long, 260 m gradient, 41 poles, start at 2,014 m of altitude). Throughout the competition the snow and weather conditions were fairly constant.

71 alpine skiers aged 40-84 years participated to this study carried out during a national competition (111.03 FIS points). They were divided into 5 years age groups. The start of the race for each group was in random order. Before the start and within 7 minutes after the finish of the competition, capillary blood samples were taken from the pre-heated earlobe and analysed with Lactate Analyzer Kontron 640. From the difference between the post-race and the pre-race values of lactate we calculated the net blood lactate accumulation (Delta La).

The 40-44 yr age group showed a higher Delta La ( $7.01 \pm 2.79$  mM) and a faster time ( $80.52 \pm 5.76$  s); the 75-80 yr age group showed a lower Delta La ( $2.20 \pm 0.95$  mM) and a slower time ( $112.19 \pm 9.38$  s). The linear relationships between Delta La and age ( $r^2 = 0.46$ ) and between time and age ( $r^2 = 0.61$ ) were both significant ( $P < 0.001$ ).

The rise in race time and the decrease of blood lactate accumulation after the race indicate a progressive increase of the contribution of the aerobic energetic sources of giant slalom with ageing. The data of the present study also indicate that the lactic power of alpine skiers decreases with age. These results are probably dependent on the reduced muscle mass and on the slower pattern of motor unit recruitment.

#### P11Q-09

### Fast vagal reactivation after submaximal exercise

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*Keywords: heart rate variability, recovery*

In contrast to autonomic modulations occurring at rest and during exercise, the mechanisms and the time course of autonomic modulations during recovery from exercise are not well documented. New methods to calculate instantaneous spectral power (i.e. time-frequency distribution) allow analyzing fast dynamic changes in autonomic modulation. The present study aimed to evaluate the time course of vagal reactivation during 15-min recovery, especially during the initial fast phase of cardio-deceleration.

Heart rate (HR), R-R interval (RRI) and high frequency power of RRI variability (HFP, as an expression of the vagal activity) were studied in 14 males and 14 females (age  $37 \pm 9$  and  $39 \pm 10$  years, height  $178 \pm 6$  and  $165 \pm 5$  cm, weight  $76 \pm 8$  and  $62 \pm 5$  kg,  $\text{VO}_2\text{max}$   $48 \pm 10$  and  $41 \pm 7$  ml/kg/min, respectively). RRIs were continuously recorded in a sitting posture before, during and after two 10-min cycle ergometer exercises at intensities of  $38\% \pm 6\%$  (low intensity, LI) and  $68\% \pm 7\%$  (high intensity, HI) of  $\text{VO}_2\text{max}$ . Short time fast Fourier transform (40s Hanning window) was used to calculate instantaneous spectral power on high frequency (0.15-0.40 Hz) band for each 200 ms and HFP and HR values were averaged for each successive 30-s during the first 5-min and thereafter for each 60-s during the 15-min recovery. ANOVA with repeated measures was used to determine significant difference of each value from pre-exercise value and difference between successive values.

HR rapidly decreased from  $107 \pm 10$  and  $146 \pm 11$  in LI and HI by  $31 \pm 9$  bpm and  $44 \pm 13$  bpm during the first 90s, respectively. The decreases in successive 30-s and 60-s HRs were significant during the first 90 seconds in LI and first 7 minutes in HI, and in LI HR reached pre-exercise level in 6 minutes. HFP of successive 30-s periods increased significantly during the first 60s and 90s after LI and HI, respectively. In LI, after slight increase from 60s to 90s, HFP decreased significantly until after 180s a plateau was attained. In HI, HFP remained unchanged after 90s. After both exercises HFP remained elevated above pre-exercise level during the recovery period of 15 minutes.

After submaximal exercises ( $38\text{-}68\%\text{VO}_2\text{max}$ ) rapid vagal reactivation occurs during the first 60-90 seconds. Thereafter, a further slow restoration of vagal activity occurs but vagal activation does not attain resting level in 15 minutes.

#### P11Q-10

### Analysis of race-performance determining factors in Olympic canoe-slalom

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*Keywords: canoe slalom, physiological profile*

It is obligatory to know the demands of the Olympic Canoe-Slalom to reach a high performance at the race. The aim of this study is to determine the physiological profile of this discipline.

A B-team was tested four times within a year ( $n=15$ , age  $18.5 \pm 2.1$  years, height  $176.3 \pm 7.8$  cm, weight  $66.2 \pm 7.8$  kg). On a standard-course in form of a figure eight, (3 poles in a line with a distance of 16 meters) slalom-similar conditions were



simulated. The sprinting ability in one lap ( $t_1$  [ $25.3 \pm 1.1$ sec]), the maximum performance over 3 laps ( $t_3$  [ $85.8 \pm 4.2$ sec]) as well as the blood-lactic maximum (Lamax [ $10.9 \pm 1.8$ mmol/l]) were determined. An incremental test has used to determine the speed at the heart rate threshold ( $v$  at HRT [ $1.94 \pm 0.05$ m/sec]) and the maximum heart-rate (HR max [ $190 \pm 6.8$ bpm]) and the oxygen uptake ( $VO_2$  max [ $3.92 \pm 0.43$ l/min],  $relVO_2$ max [ $55.0 \pm 5.5$ ml  $\times$  min<sup>-1</sup>  $\times$  kg<sup>-1</sup>]). Additionally subjects were timed over 200 meters race on flat water ( $t_{200}$  [ $66.7 \pm 3.3$ sec]). Non-specific tests in a gym were performed to determine the maximum power in pulling barbells ( $P$  max [ $78.4 \pm 12.2$ kg],  $relP$ max [ $111.8 \pm 12.5$ %]). The maximum race-specific performance was also tested on an easy course with slowly moving water ( $R$  [ $180.8 \pm 11.7$ sec]). The variables were related in a correlation-matrix. Expectedly the results of the tests with similar load structure exhibit high correlations.  $t_{200}$  and  $t_3$  correlated by 0.86 and 0.91 with  $R$ . Interesting to show is the high relationship of the sprint ability ( $t_1$ ) with race specific performance by 0.89. We may assume that the sprint ability as a semi-specific race performance rates highly as a performance-determining factor of racing in Canoe Slalom. However the aerobic efficiency does thus not serve as a sufficient criterion to explain  $R$ , but it serves as a necessary condition for the realization of high race specific performance. A high impact must be attributed also to  $P$ max and  $VO_2$ max by representing the remaining cornerstones of race-similar performance. Thus we may conclude that canoe-slalom represents a very complex kind of sport, in which the athlete, depending on his physiological disposition, can more or less effectively compensate his race performance.

#### P11Q-11

### Evaluation of excess CO<sub>2</sub> output during and after short duration - high intensity exercise

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**Keywords:** CO<sub>2</sub> output, bicarbonate buffering system, respiratory compensation

It is known that hydrogen ions (H<sup>+</sup>) produced during intense exercise are partly transported or diffused from muscle to blood resulting in the production of excess CO<sub>2</sub> output through the bicarbonate buffering system. The purpose of this study was to examine whether excess CO<sub>2</sub> output during and after short duration - high intensity exercise would be valid as an indicator of bicarbonate buffering and to investigate its relationship with exercise performance. Seven university competitive sprinters performed 40-sec maximal cycle ergometer sprinting. Excess CO<sub>2</sub> output during and after exercise was obtained through respiratory gas analysis. Furthermore, LA, pH<sub>a</sub> [HCO<sub>3</sub><sup>-</sup>] and PaCO<sub>2</sub> were obtained through arterial blood sampling. According to the method of Cerretelli and Di Pramero (1987), excess CO<sub>2</sub> output per unit of time (ExcessVCO<sub>2</sub>) was calculated by subtracting VO<sub>2</sub> from VCO<sub>2</sub> during and after exercise. Peak power/BW and Mean power/BW were measured as an index of exercise performance. The time course of the ExcessVCO<sub>2</sub> accumulative process was fitted to the [HCO<sub>3</sub><sup>-</sup>] decrease process during and after exercise. ExcessCO<sub>2</sub>, calculated as the sum of ExcessVCO<sub>2</sub> from the start of exercise to 10 min after exercise was significantly correlated with [HCO<sub>3</sub><sup>-</sup>] decrease ( $r = 0.904$ ,  $P < 0.01$ ). A significant correlation was also demonstrated between ExcessCO<sub>2</sub> and Mean power/BW during the 40-s maximal cycle ergometer sprinting ( $r = 0.859$ ,  $P < 0.01$ ).

These results suggest that ExcessVCO<sub>2</sub> during and after short duration - high intensity exercise is valid as an indicator of bicarbonate buffering, and that it could be an important factor in determining exercise performance.

#### P11Q-12

### Perceived speech difficulty during exercise and its relation to exercise intensity and physiological responses

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**Keywords:** anaerobic threshold, talk test, speech production

Purposes: (a) To establish how ratings of perceived speech production difficulty (PSPD) during exercise of varying intensities are correlated with various physiological responses (b) to determine whether the PSPD is suitable for prescribing exercise training intensity.

An incremental running test was performed in order to establish the subject's VO<sub>2</sub> max. During the test, the subjects were asked to read a written text. The subjects graded their PSPD at each stage of the test using a 13-level PSPD scale. Throughout the test, various cardiopulmonary parameters were measured breath-by-breath.

Regressions of VO<sub>2</sub>, HR, VE as a function of PSPD showed that the overall associations among those variables are strong and statistically significant ( $p < 0.05$ ). However, the individual variability within each relative VO<sub>2</sub>, VE or HR was found to be rather large. Subject's distribution in relation to their PSPD at the Ventilatory Anaerobic Threshold (VAT) scattered widely across the PSPD scale.

The "talk test" at its present non-standardized form, can not and should not be used as a substitute for the anaerobic threshold, HR, or for any other objective physiological measure for prescribing individual training exercise intensity.

#### P11Q-13

### Correlation of anthropometric parameters after 8 week resistance training

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**Keywords:** resistance strength training, hypertrophy, Wingate anaerobic test

Energy for high intensity short duration exercise is mainly provided from anaerobic sources inside the muscle itself. They include the phosphagen pool (PCr, ATP) and stored glycogen. As adaptation to the 8-wk resistance training program, it could be expected that both hypertrophic and metabolic changes will appear inside working muscles (Higbie et al., 1996). These changes were evaluated through thigh muscle cross-sectional area (CSA) and ergometric parameters.

Our investigation involved a group of 15 young male individuals ( $20.8 \pm 1.52$  y), who participated in an 8-wk resistance training (3 sessions/wk; 8 exercise/session; 3sets/exercise; 5 repetitions maximum/set). All large muscle groups were trained, with emphasis on thigh muscles. Subjects were sedentary type of persons, without organised physical activity at least 6 months prior to the study. Anthropometric estimates of thigh muscle CSA for both legs (Knapik et al., 1996) were obtained before and at the end of the 8-wk training program.

Significant increase was found (L-CSA=5.76%, R-CSA=5.85%; L-CSA  $p<0.01$ , R-CSA  $p<0.01$ ). Parameters of anaerobic capacity were assessed using Wingate anaerobic test (WAnT) lasting for 30 s, at the beginning and at the end of the 8-wk program. The changes of parameters that define anaerobic capacity were: peak power (PP) ( $p<0.05$ ; 651.00 W vs. 731.82 W), peak power/body mass (PP/BM) ( $p<0.01$ ; 9.11 W/kg vs. 12.21 W/kg), and index of fatigue (IF) ( $p<0.01$ ; 46.83% vs. 63.50%). In relative values these increases were as follows: PP by 12.24%, PP/BM by 34.03%, and IF by 16.67%. Significant correlation was established between the PP gain and the thigh muscle CSA increase of left and right thigh muscles after 8 weeks of resistance training ( $p<0.05$ ). There were no positive correlation between thigh CSA and values of PP. This indicates that anaerobic energy output depends only on thigh muscle CSA, and that increase of this parameter is connected with improvements in anaerobic capacity as well.

We can conclude that 8-week resistance training induces significant changes in anaerobic capabilities of the working muscles, and that hypertrophic changes follow up the metabolic ones.

Knapik et al (1996). *Med Sci Sports Exerc* 28 (12): 1523-1530

Higbie et al (1996). *J Appl Physiol* 81(5): 2173-2181

#### P11Q-14

### Changes in cardiac vagal activity during 165 km marching

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**Keywords:** heart rate, marching, military

Frequency domain analyses of heart rate (HR) variability is the non-invasive, most commonly used method to evaluate the autonomic regulation of HR. Withdrawal of vagal activity occurs during an acute dynamic exercise resulting in a decreasing beat-to-beat R-R interval fluctuation (Tulppo et al 1998). The effects of long-term exercise stress on autonomic regulation are not well known. We tested the hypothesis that the long-term exercise stress results in decreased cardiac vagal activity.

A Finnish Cadet team ( $n = 8$ , age  $25 \pm 2$  yr, height  $1.80 \pm 0.09$  m, maximal oxygen uptake  $55 \pm 6$  ml/kg/min) participated in the military marching in Nijmegen, Holland. The marching exercise lasted four days including 40 km marching sessions every day (totally 165 km). The exercise started at 5 o'clock every morning. The subjects were carrying a bag with a minimum weight of 10 kg plus all the food and drinks (a total weight of 12-14 kg). Cardiovascular autonomic function was assessed by measuring HR and a high frequency (HF 0.15-0.4 Hz) and low frequency (LF 0.04-0.15 Hz) spectral power of HR variability from the 5-min R-R interval recordings at rest. The R-R intervals were recorded one day before marching (baseline), 6 h after the marching (at 8-9 PM) in the first and last days, and finally after 10-14 days recovery.

The mean ( $\pm$ SD) marching time was 7 h 55 min  $\pm$  17 min. The heart rate increased from the baseline of 62(6 bpm to 72(6 bpm ( $p<0.01$ ) recorded after the fourth day of marching, while simultaneously HF power decreased from 8.16(0.90 to 7.05(1.37 ( $p<0.01$ ).

However, the mean HR and vagally mediated beat-to-beat R-R interval oscillation (HF-power) markedly changed already after the first day of long-term marching. The increased HR after marching may occur due to the decreased cardiac vagal outflow. Similar long-term changes were also observed in

autonomic function after a prolonged cross-country skiing competition (Hautala et al 2001). These changes probably reflect a compensation for altered cardiovascular haemodynamics after prolonged exercise, e.g. a reduced left ventricular systolic function after prolonged exhaustive exercise (Niemelä et al 1984).

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#### P11Q-15

### High altitude effects on isometric force characteristics

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**Keywords:** high altitude, static MVC, isometric endurance

Research on muscular and organic adaptation to acute or chronic exposition to high altitude started 40 years ago. The aim of our study was to evaluate isometric force modification after a 27 days exposition to high altitude ( $> 5600$  mt).

10 healthy trained males (age  $37.2 \pm 11.9$ , weight  $69.4 \pm 9.2$  kg; height  $175 \pm 6.1$  cm; muscle mass  $49.5 \pm 3.6\%$ ; fat mass  $12.2 \pm 2.8\%$ ) performed tests at sea level before the expedition (B) and 7 days after they left the 5600 mt camp (A). Two tests were performed with the dominant (D) and the non dominant (ND) arm: 1) maximum voluntary contraction test (MVC) of elbow flexors; 2) resistance test maintaining the isometric contraction at 80% of MVC  $\pm 10\%$ .

Significant modifications after high altitude exposition were found for: weight ( $69.4 \pm 9.2$  kg B;  $68.8 \pm 7.6$  kg A;  $p<0.005$ ); BMI ( $22.5 \pm 2.3$  B;  $22 \pm 2.3$  A;  $p<0.01$ ); muscle mass ( $49.5 \pm 3.6\%$  B;  $47.8 \pm 3.6\%$  A;  $p<0.05$ ); MVC for D and ND arm (D:  $38.2 \pm 6.28$  kg B;  $35.3 \pm 6.8$  kg A;  $p<0.05$ ; ND:  $37.7 \pm 5$  kg B;  $33.3 \pm 5.4$  kg A  $p<0.01$ ) endurance time (ET) for both arms (D:  $21.9 \pm 10.8$  s B;  $14.8 \pm 7.1$  s A  $p<0.05$ ; ND:  $19.2 \pm 9.6$  s B;  $16.2 \pm 10.1$  s A  $p<0.05$ ) and MVC time development (RFD) at 90%-100% of MVC only in the ND arm (90%:  $0.33 \pm 0.2$  s B;  $0.47 \pm 0.3$  s A  $p<0.05$ ; 100%:  $1.02 \pm 0.4$  s B;  $1.29 \pm 0.5$  s A  $p<0.005$ ).

After a long permanence at high altitude, isometric force of upper limbs is reduced, both in the expression of a maximal voluntary contraction and, in agreement with previous works, in endurance time at 80% of MVC. This can be explained by the significant loss of muscle mass and in particular by a loss of FT fibers. In fact, according to some authors, for contractions at high MVC%, fatigue onset is related to an increased motor unit recruitment, suggesting that the muscle fibers involved in this recruitment are the FT. We think that the increase in RFD 90% and 100% only in the ND arm can be attributed to a greater difficulty in synchronization and recruitment in the less-trained arm that can enhance the effect of muscle mass reduction. This is also confirmed by a significant difference between D and ND arm for MVC in the A test ( $p<0.05$ ), whereas no difference was found between the two arms in the B test.

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## P11Q-16

**Peripheral fatigue in rock climbing; possible role of ammonia****Milic Radoje, Leskosek Bojan**

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*Keywords: lactate, rock climbing, ammonia*

Rock climbing is a highly demanding competitive sport with certain physiological adaptations that occur in response to specific effort during event, which allows the elite climber to perform more effectively and delay the development of fatigue. It is also clear that it requires adequate decisions according the proper technique which has to be used. One of the studies dealing with blood lactate response to competitive climbing has shown that the blood lactate levels reached by 46 of the climbers taking part in the UIAA world championship in 1993 in Innsbruck were not higher than 8.5 mmol/L. Extensive ammonia accumulation in blood can occur during very intense and short-term exercise and after sustained isometric contractions. Our study was performed to evaluate the role of ammonia among various possible causes of peripheral fatigue in rock climbers.

Six top performance rock climbers (2 women and 4 men) participated in our study. Graded exercise test were performed on the customized stairway ergometer especially constructed for physiological and biomechanical measurements in sports climbing. We collected 2 times 5 ml of whole blood samples from cubital vein, before and immediately after finishing the test for NH<sub>3</sub> and lactate analysis.

Test lasted, averagely, 183,5±56,2 sec. We found that post-test serum concentrations both for lactate (5,25± 0,26 mmol/L vs. 2,03± 0,14 mmol/L ) and ammonia (112,83± 43,82 mmol/L vs. 33,83± 4,54 mmol/L ) significantly differ from pre-test values ( $p < 0.05$ ).

Intense exercise increased the turnover rate of high-energy phosphates in working muscles. At the limits of performance, this high turnover also leads to contractile failure. During intense exercise, depletion of phosphocreatine, limitation of glycolysis due to lack of substrate and poor oxygen delivery in upper extremities are factors which enhance AMP deamination and cause rapid and extensive increase and accumulation of IMP in working muscle. Future research with larger samples has to be done either in simulated laboratory conditions or in field (training and competition) conditions to support our findings.

## P11Q-17

**Personal features of the development of young sportsmen****Rogaleva Liudmila, Malkin Valeriy**

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*Keywords: sportsmen*

The analysis of sport performances of young sportsmen shows, that almost 70 per cent of the young sportsmen have instable results. Therefore many of the young sportsmen leave sports, not realizing their abilities. Two types of coaches were allocated: the coaches oriented on sports result only and the coaches with professional - pedagogical orientation. The coaches oriented on results only do not take into account features of personal development of the young sportsmen.

A 16-PF test (Kettell), methods to study self-estimation, motivation and anxiety were used. 352 young sportsmen at the age from 14 to 16 years took part in the research.

The quantity of sportsmen with lower self-estimation increased from 23 % to 36 %, the quantity of sportsmen with an adequate self-estimation reduced from 39 % to 25 % in groups of the coaches who were focussed on results. There was a decrease of emotional stability with 5,5 to 4,2, self-control with 6,3 to 4,7 ( $? < 0,05 - 0,01$ ), growth of uncertainty with 5,6 to 7,8 and uneasiness with 6,2 to 8,0. In groups of coaches with professional - pedagogical orientation growth of adequate self-estimations from 39 % to 63 %, was observed and decreases in quantity of sportsmen with an overestimated self-estimation from 37 % to 24 % and lower self-estimation from 24 % to 13 % was observed. Simultaneously, increases were found of parameters of the emotional stability with 6,1 to 7,7, self-control with 6,2 to 8,5 ( $P < 0,05 - 0,001$ ), decrease of a parameter of the uneasiness from 5,7 to 4,9 in the young sportsmen.

The given fact testifies that orientation of the coach only on results in sport activity does not promote development of the psychologically stable person of the young sportsman. The absence of confidence, presence of a internal conflict, anxiety and uneasiness not only can conduct to various psychological failures constraining development of the person but also to reduce successful performances in competitions. Pedagogical-professional orientation in work of the coach promotes development of the young sportsmen personal qualities, which can provide mental stability.

## P11Q-18

**The length-tension relationship of the knee extensors after a single bout of downhill walking****Chapman Phillip, Budde Henning, Chen Wan, Fonda Jan, Thompson Martin**

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*Keywords: downhill walking, length-tension, eccentric contraction*

Eccentric muscle contractions of sufficient force, duration and stretch are associated with post exercise muscle weakness and soreness. This weakness has been associated with sarcomere damage and/or disturbances in excitation-contraction coupling. Morgan (1990) has put forward the hypothesis that sarcomere inhomogeneity and instability leads to elongation of the muscle due to sarcomere "popping" or damage resulting in a subtle shift in the peak of the force-length curve to longer muscle lengths. Therefore, the aim of the present study was to test the hypothesis that a single bout of downhill walking will shift the peak of the length-tension relationship of the knee extensors towards longer muscle lengths and to determine the time-course of recovery. Six active males (age: 35.3 ± 11.3 years, wt: 73.1 ± 7.8kg, mean ± SD) performed a 40 minute bout of downhill walking on a treadmill at a gradient of -26.2% with a walking speed of 6.4 km/h. The maximal isometric torque of the knee extensors was measured at 10 different knee angles at 5 degree increments (50-95° respectively) on a Biodex™ dynamometer before (PRE) and after the downhill walk at 5 fixed time periods (3, 24, 48, 72, 144 hours respectively)(H). The torque values were normalized for cross-sectional area (T) of the quadriceps muscle group determined with ultrasound.

After downhill walking T was significantly depressed at all angles at 3, 24, 48 and 72H ( $p < 0.05$ ). No significant difference was observed at 144H. No observable shift in the peak of the torque-angle curve was evident after the downhill walk task since there was no accentuated decline in strength at the shorter muscle lengths compared to longer ones. This

may suggest impairment of excitation-contraction coupling initially rather than any specific ultra structure damage aetiology. This study has shown significant reductions in isometric strength of the quadriceps across a range of muscle lengths that persist for at least 72 hours following 40-

minutes of downhill walking. However, there was no evidence of a rightward shift of the length-tension relationship in response to eccentric contractions from a single bout of downhill walking.

## Poster Session

### Physiology 6

P11R

P11R-01

#### A comparative analysis of two intermittent training sessions aiming at VO<sub>2</sub>max development in top elite athletes

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**Keywords:** VO<sub>2</sub>max, intermittent training, elite athletes

This study aims at comparing the physiological impact of two different training sessions commonly designed by coaches in running. The two sessions proposed are intermittent sessions of equal total duration (20 min) but specific running interval duration (30 or 100 sec).

Nine middle-distance specialists (800 to 3000m) of national or international calibre participated in this study. Two sessions were proposed: (1) 6\*600m track (IT100) at 102% Maximal Aerobic Speed (MAS), (2) 30 sec~30 sec (IT30) session at 105% MAS. Recovery time was equal to exercise time and imposed a running activity corresponding to 50% MAS. These two sessions were preceded by a progressive VO<sub>2</sub>max evaluation test consisting in speed-incremented 3-min run bouts separated by 1- min rests.

Aerobic solicitation was estimated as follows: 1) VO<sub>2</sub>peak during the sessions, 2) relative time spent at 95 or 98% and more of VO<sub>2</sub>max in each session, 3) VO<sub>2</sub> mean solicitation during the entire session (effort and recovery).

Anaerobic solicitation: Lactate levels are significantly higher for IT100 (13.2 mmol.l<sup>-1</sup>) than IT30 (8.3 mmol.l<sup>-1</sup>).

These results suggest that long-interval (100 sec) track sessions are physiologically more demanding as compared to short ones (30 sec): 43.7% and 9.3% of time spent at 95 and more of VO<sub>2</sub>max for IT100 and IT30, respectively. Even at 105% MAS, subjects did not reach VO<sub>2</sub>max during IT30 (VO<sub>2</sub> pic = 95.78% VO<sub>2</sub>max). From this perspective, results confirm with elite runners those presented by Millet et al. 2000. Interestingly, when the entire session is considered, IT30 induces a higher mean aerobic participation (75.06% of VO<sub>2</sub>max), as evidenced in the higher VO<sub>2</sub> values recorded during each recovery phase.

Finally, in contradiction with hypotheses raised in previous studies (Christensen et al, 1960), it seems that short intermittent exercises induce participation of the anaerobic metabolism, although significantly not as important as in longer interval sessions. In this context, recovery appears to be not long enough and/or too severe to allow a complete refill of myoglobin oxygen and phosphocreatine stores. Further studies are needed, that would assess exercises of higher intensity (110% MAS) or shorter recovery (75% of exercise duration) in IT30 sessions, in order to clarify whether VO<sub>2</sub>max is reached or not in short-interval exercises.

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P11R-02

#### Interpretation of the parameters of various models of endurance performance

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**Keywords:** performance, critical power, anaerobic working capacity

The purpose of this study was to analyse the physiologic meaning of the parameters from power-time relationship including anaerobic work capacity (AWC), critical power (CP) and maximal instantaneous power (Pmax). From 5 formulations of the power-time model, CP was compared with power at ventilatory threshold (VT) and AWC with maximal accumulated oxygen deficit (MAOD). Pmax values were compared to maximal power during an explosive exercise on cycle ergometer taking pedalling frequency into account.

11 male subjects (mean ± SD age = 23.2 ± 1.3 yr; height = 179 ± 8 cm; weight = 73 ± 9 kg) completed after an inclusion visit (ramp test 15 W/min at 75 rpm to exhaustion): 4 ramp tests, 4 rectangular trials to exhaustion at 75 rpm at work rates to have exercise time between 2 and 30 min, 1 test to measure MAOD and 6 all out tests lasting 5 sec using friction-loaded of 25, 50 and 75 g/kg body weight to obtain power-velocity relationship. The equation of power-velocity relationship was used to determinate the maximal power at optimal velocity and at 75 rpm. Power at VT was estimated during the first ramp test. Data on time trials were fitted with simple hyperbolic model using one non linear form: Nlin-2:  $T = AWC / (P - CP)$  and 2 linear forms Lin-P:  $P = CP + AWC / T$  and Lin-W:  $P.T = CP.T + AWC$ . Pmax was introduced in 2 other models: an extended hyperbolic model: Nlin-3:  $T = AWC / (P - CP) - AWC / (Pmax - CP)$  and an exponential model: EXP:  $P = CP + (Pmax - CP).exp(-T/Tau)$ .

Fitting Nlin-3 model to the data yielded to 2 disproportionate values for CP, AWC and Pmax which were not included in the following comparisons. Only CP estimated from Nlin-3 (202 ± 41 W) was statistically different from power at VT (227 ± 31 W). Power at VT was significantly correlated only with CP estimated from the 3 simple hyperbolic models: R<sup>2</sup> ranged from 0.76, P < 0.01 to 0.94, P < 0.001. MAOD (13.5 ± 24.9 kJ) was statistically different from AWC from all models (P value ranged from 0.05 to 0.001). MAOD was significantly correlated only with AWC from Nlin-2 (R<sup>2</sup> = 0.64, P < 0.01) and with Tau from EXP model (R<sup>2</sup> = 0.56, P < 0.01). Pmax at Vopt (1189 ± 108 W) and at 75 rpm (877 ± 86 W) were significantly higher than Pmax from extended models without significant correlation between these variables. In conclusion, the introduction of Pmax did not improve the interpretation of the physiologic meaning of the models parameters. The number of measurements could be also a critical factor for fitting the extended hyperbolic model but not for EXP model.

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## P11R-03

**Neural aspects of initial strength gain**

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**Keywords:** EMG, training, strength

Resistance training with concentric and eccentric muscle action elicits gains in strength that are greater than increases in muscle size during the initial phase of training (Moritani and DeVries, 1979). These early changes are mainly related to the onset of neural adaptations, although their exact nature is unclear (Cannon, 1987).

Effects of 8-week heavy-resistance training of lower leg extensors on isokinetic strength and neural activation were examined in 12 sedentary young men (age 22±1 yr), who have not been actively involved in any regular sports activities during the last six months prior to the examination. The resistance-training program included 3 sessions a week on the leg press machine. In each session 4 series of concentric muscle actions one serie of eccentric actions were performed. Isokinetic strength of lower leg extensors and integrated electromyographic activity (IEMG) of m. vastus medialis were obtained before, after the 4th week and at the end of the 8-week training program.

Isokinetic strength of lower leg extensors increased by 8.15±1.67% ( $p<0.01$ ) for the left and 8.12±1.38% ( $p<0.01$ ) for the right leg after 4 weeks. At the end of the 8th week gains in strength of left and right lower leg extensors were 15.80±2.46% and 15.34±2.24% ( $p<0.01$ ), respectively. After the 4th week IEMG of left and right vastus medialis increased by 12.41±1.89% ( $p<0.01$ ) and 11.91±1.77% ( $p<0.01$ ). In the second half of the 8-week training program further increases in IEMG activity were observed (2.13±0.35 and 1.87±0.32 ( $p>0/05$ ), respectively).

Increases in neural activation were more significant in the first part of the training program and in this period strength gains of lower leg extensor correlated with the increases in IEMG activity ( $t=0.56$ ,  $p<0.05$ ). From the results obtained we conclude: a) 8-week heavy-resistance training with concentric and eccentric muscle actions leads to significant strength gains; b) Strength gains in this period show a linear character; c) Increases in neural activation are more significant in the first half of the 8-wk program; d) Early changes in strength may be accounted for largely by neural factors; e) Strength gains in the second half of the training program are not likely to be related only to increased neural activation.

## P11R-04

**Effects of spontaneous exercise on antioxidant capacity in rat muscle determined by electron spin resonance**

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**Keywords:** antioxidative capacity, electron spin resonance, spontaneous exercise

The effect of physical activity on antioxidant capacity in muscle remains unknown. The present study was carried out in order to examine effect of spontaneous exercise on antioxidant capacity in rat skeletal muscles measured by electron spin resonance (ESR) with spin-trap technique and to compare the differences in adaptive response of the

antioxidant capacity among the muscles with different contractile and metabolic characteristics.

Ten-week-old male Wistar rats ( $n=23$ ) were individually housed in cages with a freely-moving running wheel with a 31 cm diameter. A standard chaw and water were provided ad libitum. The rats were eventually classified into three groups based on 431.7±353.5 km (mean±SD) of running distance covered by them for 22 weeks (running distances of high, middle and low activity group were 922.4±66.5, 418.6±242.0 and 49.1±21.6 km, respectively). Soleus, plantaris, gastrocnemius (deep/surface portions) and heart muscles were isolated, and scavenging activity against superoxide anions and hydroxyl radicals of these specimens were determined by ESR using a spin-trapping chemical (5, 5-dimethyl-1-pyrroline-N-oxide: DMPO). The citrate synthase (CS) activity and cytochrome c oxidase (COX) activity of these muscle specimens were analyzed as a marker of oxidative phosphorylation capacity in mitochondria.

Only the superoxide anions scavenging activity significantly in deep portion of m. gastrocnemius correlated with the running distance ( $r=0.67$ ,  $p<0.01$ ). The high activity group had the highest superoxide anions scavenging activity in heart. In the plantaris, the superoxide anions scavenging activity of the middle activity group was significantly higher than that of the low activity group ( $p<0.01$ ). The superoxide anions scavenging activity of the soleus and surface portion of m. gastrocnemius was no significant difference of the three groups. The hydroxyl radicals scavenging activity did not correlated with the running distance in all muscles. There was no significant difference in the CS and COX activity between the three groups.

The present study suggested that the scavenging activity (especially, against superoxide anions) in skeletal muscle would be affected by spontaneous exercise volume. It is possible that muscles with moderate oxidative metabolic capacity but with fast motor units are susceptible to up-regulation of the scavenging capacity.

## P11R-05

**Modulation of preactivation and stretch reflex by different contact surfaces and visual inputs during movement to absorb impact**

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**Keywords:** EMG, motor control, reflex gain

During hopping humans adjust leg stiffness depending on surface characteristics, but it is less obvious how leg stiffness is modulated during landing. Hopping requires spring properties of the muscles, while landing seems to require damping ones. Accordingly, it is noteworthy to investigate how preactivation (PA) and stretch reflex are adjusted for different surfaces during landing. In addition, the visual input may be connected to changes in reflex gain. However it has not shown that modification of stretch reflex without visual input also functions similarly in soft surface landings with less impact. Therefore the purpose of this study is to examine the effect of different surfaces and visual inputs on electromyographic (EMG) activities during movement to absorb impact force.

The trials were conducted using a special sliding apparatus. Subjects ( $n=6$ ) slid down a constant distance with a slope of 15 degrees from sitting position and made contact feet on the force platform fixed perpendicular to sliding rails. The trials included different surface contacts on hard surface (HS) of the force platform and soft surface (SS) of thick foam cushion with either eyes open (EO) or eyes closed (EC). During

movements, EMG activities of the soleus (Sol), the medial gastrocnemius (MG) and the tibialis anterior (TA) muscles, the displacement in the knee and ankle joint, and the contact force were recorded.

With EO, the temporal patterns of EMG were almost similar regardless of the changes in different surfaces. For the change of impact force, there was not much modification of PA, whereas the amplitudes of stretch reflex in Sol were considerably increased on HS. With EC, even in subjects whose PA activities in all muscles were not influenced by the removal of visual input, the responses of the stretch reflex in Sol were larger than that in EO on both surface conditions. Additionally, there was no evidence of adaptation of PA with respect to the trial number at each condition despite unfamiliar contact on SS and/or with EC.

It is suggested that central program is not modified largely by expected impact force and might be set broadly. As for visual input, in spite of surface conditions, it appears that occlusion of visual inputs might increase the response of stretch reflex by modulations in reflex gain. Therefore, these results may emphasize the importance of reflex modulation during movement to absorb impact.

#### P11R-06

### Muscle oxygen saturation measurements during training in Ironman triathletes

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*Keywords: training, triathlon, muscle oxygen saturation*

In order to maximize exercise performance, much time and thought should go into a training program. Exercise testing should be a part of any training program to insure that undertraining and overtraining do not occur and that maximal improvements in exercise performance occur. Previously we have shown that muscle oxygen saturation (StO<sub>2</sub>) can be used to determine blood lactate breakpoint and maximal lactate steady state speed. Also, StO<sub>2</sub> curves from incremental exercise have been shown to track changes in blood lactate curves and training adaptations during a training season.

To determine if individual resting, low and recovery muscle StO<sub>2</sub> values along with the recovery time value track changes in training adaptations throughout a training season. Sixteen triathletes (males=12, females=4) training for an Ironman event were monitored four times (January, March, May, and August) prior to a September competition. During each testing session, five minutes of standing resting StO<sub>2</sub> were obtained prior to a six-minute, five-stage, incremental running test. A controlled (3.0 mph for 5 minutes) recovery then occurred to determine recovery StO<sub>2</sub>, followed by a maximal test. Oxygen uptake variables and StO<sub>2</sub> of the gastrocnemius through near-infrared spectroscopy (NIRS) were obtained continuously throughout the exercises, while blood lactate was determined on blood obtained at the end of each workload. Thirteen athletes finished the Ironman, two athletes did not compete due to injuries, and one athlete did not finish. Complete data were obtained on nine athletes.

The trends for Resting StO<sub>2</sub>, Lowest StO<sub>2</sub>, and Recovery Time were all similar with the muscle oxygenation lowest (recovery time longest) in March, followed by an increase in May (recovery time shorter), with the highest StO<sub>2</sub> values of all reached in August. However, none of these differences were statistically significantly different. Most athletes complained of being fatigued in March and May, but ready for the Ironman event in August, which would parallel what the muscle StO<sub>2</sub> data seemed to indicate.

Further study would seem to be warranted as the trends in individual values of muscle oxygen saturation would seem to indicate changes occurring during the training season.

#### P11R-07

### The level of physical activity and growth hormone (GH) response to acute constant work load

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*Keywords: physical activity, growth hormone*

There is no clear evidence about the influence of programming physical activity on GH response during acute exercise.

The aim of this study was to compare serum levels of GH in response to exercise in trained vs. untrained (sedentary) males.

The study was performed with 20, healthy male subjects. Based on the level of their physical activities they were divided in two groups: group 1. Trained (N=10) and group 2. Untrained. All subjects exercised 30 minutes in sitting position on a cycle ergometer (work intensity 50% of VO<sub>2</sub> max, RPM 60/min). Serum GH concentrations were measured by IRMA (immunoradiometric assays) methods, in samples obtained at rest and at 6-min intervals during exercise.

The sedentary subjects had a higher heart rate at rest, during exercise and in the recovery period. Although serum GH concentrations were higher in almost all samples in the sedentary group, there were no statistical differences in GH serum concentration between trained and untrained subjects. There were marked individual differences in GH response to exercise in both groups.

We conclude that training status has no influence on GH response during acute constant work load.

#### P11R-08

### The influence of reduced breathing during intense swimming on some respiratory and metabolic parameters

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*Keywords: swimming, reduced breathing, respiratory acidosis*

Swimming training with controlled breathing frequency (breath every four, six or eight strokes during crawl swimming) is often referred to as "hypoxic training". In some previous studies swimmers restricted the breathing frequency during tethered flume swimming (Dicker, Lofthus, Thornton, Brooks, 1980; Town and Vanness, 1990), during interval training (Holmer, Gulstrand, 1980) and during swimming at OBLA velocity (Kapus, Ušaj, Kapus, Štrumbelj, 2002). These studies were unable to demonstrate reduced arterial oxygen saturation with this training technique, but did show a systematic hypercapnia. It was also presumed that influences of reduced breathing during swimming would be more evident at higher velocity. Therefore the purpose of the present study was to ascertain the influence of reduced breathing on the blood acid-base status during swimming at 90% velocity of maximal 200-m front crawl.

Ten recreational level swimmers (age 16,6  $\pm$  1,8 years, height 180  $\pm$  7 cm and weight 70  $\pm$  7 kg) volunteered to participate at this study. First, swimmers performed maximal 200-m front crawl swim. Thereafter, they perform submaximal swimming twice: first, by breathing every two strokes (B2), and second, by breathing every four strokes (B4). They swam as long as possible at fixed, pre-determined velocity. That was 90% of velocity, reached at 200-m front crawl. Measures included lactate concentration ([LA]) and parameters of blood acid-base status (pH, Po<sub>2</sub>, Pco<sub>2</sub>) before and during the first minute after the exercise. The paired t-test was used to compare the data between submaximal swimming in two different breathing conditions. All statistical parameters were calculated using the graphical statistics package SPSS.

Swimmers swam with B2 significantly longer (510  $\pm$  147 m) as they did with B4 (378  $\pm$  73 m) ( $p < 0.05$ ). [LA] was significantly lower after swimming with B4 (9  $\pm$  2,3 mmol/l) than after swimming with B2 (11,1  $\pm$  1,4 mmol/l) ( $p < 0.05$ ). Pco<sub>2</sub> (5,5  $\pm$  0,8 kPa) and [HCO<sub>3</sub><sup>-</sup>] (16,6  $\pm$  1,6 kPa) were significantly higher after swimming with B4 than after swimming with B2 (4,7  $\pm$  0,4 kPa and 13,9  $\pm$  1,6 mmol/l) ( $p < 0.05$ ). Po<sub>2</sub> (10,9  $\pm$  0,8 kPa and 10,8  $\pm$  0,7 kPa) and pH (7,22  $\pm$  0,05 and 7,22  $\pm$  0,07) did not change significantly in response to reduced breathing during swimming. It may be concluded that the combination of severe hypercapnia, respiratory acidosis and metabolic acidosis was a possible reason why swimmers had to stop earlier due to fatigue, when breathing every four strokes.

#### P11R-09

### The peculiarities of cardiac structure and function in athletes with different levels of qualification according to the echocardiography and HRV data

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**Keywords:** endurance athletes, cardiac structure and function, level of qualification

As a result of physical training activities, a heart of an athlete experiences certain morphological and functional changes, which lead to the formation of "athlete's heart". Endurance-trained athletes usually demonstrate eccentric left ventricular (LV) hypertrophy with a simultaneous decrease of heart rate (HR) and increase of the parasympathetic influence on cardiac activity. The purpose of this research is to compare the expression of these changes in athletes with different levels of qualification.

We studied 21 endurance-trained athletes (males, aged between 18 and 27) from the Eney Athletic Club (Lviv, Ukraine). They were divided into three groups according to their level of qualification and IAAF scores ( $p < 0,05$  between groups): group A - middle-level athletes ( $n=7$ ; 20,3  $\pm$  1,5 years); group B - high-level athletes ( $n=7$ , 20,1  $\pm$  1,7 years); and group C - elite athletes ( $n=7$ , 23,1  $\pm$  2,9 years). Cardiac structure and function of the athletes were measured by echocardiography, and a cardiac autonomic balance - on the basis of HR variability (HRV) data.

According to the echocardiography data, athletes from the B and C groups, compared to the group A, were characterized by LV wall thickening ( $p=0.055$  and  $0.058$  respectively) with a simultaneous increase of LV radius (5,50 $\pm$ 0,18; 5,40 $\pm$ 0,36 and 5,03 $\pm$ 0,33 respectively) and, as a result, increase of LV end-diastolic volume and significant increase of LV mass ( $p < 0.01$ ). However, only the group C athletes, having the

lowest HR (49.3  $\pm$  6.8) compared to groups A (HR=62.4  $\pm$  6.7,  $p=0.015$ ) and B (HR=55.3  $\pm$  1.8,  $p=0.063$ ), demonstrated significant increase of stroke volume ( $p < 0.05$ ) and stroke index ( $p < 0.05$ ). Based on HRV data, the higher the level of qualification is, the SDNN, pNN50% and total power parameters significantly increase. The part of the parasympathetic component (HF) in the total spectrum structure enhances mostly at the cost of the sympathetic one (LF), and sympatho-vagal balance (LF/HF) decreases. That is, the higher level of qualification is characterized by the increase of LV dimensions and mass with a simultaneous decrease of HR and enhancement of HRV with dominance of the parasympathetic component in the total spectrum.

Advancement of the level of qualification during endurance training results in changes of the cardiac structure and function in athletes. The dynamics of these variables' changes indicate training efficiency and level of performance qualification.

#### P11R-10

### Leptin responses to a 30-min maximal rowing ergometer exercise in male rowers

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**Keywords:** leptin, maximal exercise, rowing

Prolonged physical activity has been reported to reduce plasma leptin levels. In contrast, it has been suggested that a short-term exercise has no effect on plasma leptin levels as the exercise mediated energy expenditure may not reach a critical level that is needed for plasma leptin levels to be reduced. However, no studies have yet investigated the effect of short-term maximal exercise on plasma leptin utilizing an exercise protocol where all major muscle groups are involved. Plasma leptin response to a 30-min maximal ergometer rowing was investigated in male college level rowers.

Ten rowers performed maximal 30 min of ergometer rowing (covered distance: 7870.40 $\pm$ 443.30 m; blood lactate immediately after the test: 14.9 $\pm$ 4.3 mmol.l<sup>-1</sup>) and venous blood samples were obtained before, immediately after and after 30 min of recovery. In addition to leptin concentration, insulin, growth hormone, insulin-like growth factor-I (IGF-I) and IGF binding protein-3 (IGFBP-3) values were measured in blood.

Plasma leptin was significantly decreased (from 2.31 $\pm$ 1.54 to 2.07 $\pm$ 1.47 ng.ml<sup>-1</sup>) after the first 30 min of recovery. The concentration of growth hormone was significantly increased immediately after the maximal 30 min of rowing ergometer test. All other measured blood values were not significantly changed at any measured time point. Regression analysis demonstrated a positive relationship between a non-significant decrease in the level of plasma leptin immediately after the 30 min of maximal ergometer rowing and a covered distance ( $R^2=0.645$ ;  $p < 0.05$ ). In addition, changes in plasma leptin levels were related to changes in IGF-I levels immediately after the test ( $R^2=0.390$ ;  $p < 0.05$ ). Basal leptin was significantly correlated only with plasma insulin ( $r=0.88$ ;  $p < 0.05$ ).

In conclusion, the present study demonstrated that circulating plasma leptin is lowered during the first 30 min of recovery after maximal exercise, when all body major muscle groups are involved. Furthermore, the total mechanical work performed by the muscles explained 64.5% of the post-exercise plasma leptin concentration. Changes in leptin values as a result of acute short-term exercise could occur via insulin-dependent mechanism.

## P11R-11

**Effects of warm up on thermoregulation and repeated-sprint performance in hot conditions****Bishop David, Maxwell Neil**

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*Keywords: rectal temperature, intermittent exercise, heat illness*

While active warm up has been reported to improve long-term (> 5 min) performance, active warm up may have a detrimental effect if it causes a significant decrease in heat-storage capacity and the earlier attainment of a high rectal temperature (Tr). The purpose of the present study was to determine the effects of an active warm up on thermoregulatory responses and repeated-sprint performance in hot, ambient conditions.

Eight male, team-sport athletes (mean  $\pm$  SD, age: 23.4  $\pm$  6.2 y, mass: 76.8  $\pm$  7.7 kg, VO<sub>2</sub>max: 59.9  $\pm$  8.0 mL/kg/min) performed a repeated sprint test (RST) for 36 min in hot ambient conditions (35.5  $\pm$  0.6 °C, RH 48.7  $\pm$  3.4%) after no warm up (WUP 0), 10-min warm up (WUP 10) or 20-min warm up (WUP 20). Based on a motion analysis of international men's field hockey, the RST was designed to mimic one half of a typical team-sport game. The protocol was divided into ~ 2-min blocks consisting of a 4-s sprint, 100 s active recovery (35% VO<sub>2</sub>max) and 20 s passive rest. On two occasions during the 36-min protocol, there was a repeated-sprint bout (RSB) comprising five, 2-s sprints, where the active recovery between successive sprints was ~ 20 s.

There were no significant differences between conditions for mean work (kJ/sprint), peak power (W) or work decrement (%) during the RST. However, the mean work performed was significantly less in RSB2 than RSB1 for WUP 20 only ( $P < 0.05$ ). While blood lactate concentration was significantly higher after active warm up (WUP 20 = WUP 10 > WUP 0;  $P < 0.05$ ), there were no significant differences between conditions following either RSB. Tr was also significantly higher after active warm up (WUP 20 > WUP 10 > WUP 0;  $P < 0.05$ ) and these differences were maintained throughout the RST.

Although active warm up resulted in a greater increase in Tr, it did not affect repeated-sprint performance in the heat in trained team-sport athletes. Despite similar changes in Tr, it has previously been reported that active warm up decreases intermittent exercise time to exhaustion in healthy males. However, the test used did not simulate team-sport performance and nor were the subjects team-sport athletes. As active warm up did not improve repeated-sprint performance (< 40 min), team sport athletes may be able to minimise changes in Tr (and the likelihood of heat illness) by avoiding excessive warm up when exercising in the heat.

## P11R-12

**A scientific approach to determine divers physical fitness under water****Hoffmann Uwe, Dräger Tobias, Birken Marc, Lange Konrad**

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*Keywords: underwater testing, scuba diving, fin swimming*

To evaluate physical fitness of SCUBA divers, standard ergometer tests are applicable. Thus, special test tools and routines are required. Several parameters can be examined to judge the individual work load, i. e. the heart rate,

ventilation, and O<sub>2</sub> uptake. Certain aspects should be considered, such as influence of psychological stress on the ventilation. Heart rate has been proved to be easily detectable and to apply. However, for a valid interpretation of heart rate responses the influences of environmental factors and other physiological parameters have to be taken into account.

With regard to the specific physical fitness of SCUBA divers two aspects are of practical relevance: the efficiency of movement, i.e. under water fin swimming, and the maximal power which might be generated in critical situations under water or on the surface.

Therefore a special test tool to examine divers under water was developed. This device permits two different routines: 1. Speedtest: highest possible speed for a short time, 2. Steptest: standard step-test with speeds of 0.4, 0.6, 0.8 m s<sup>-1</sup>, of two minutes duration each.

The prototype device of the first increment is based upon a commercially available data-logger, an impeller system and telemetric system to detect heart rate (Polar®). All signals are transmitted wirelessly and stored on the data logger. The data logger also acts as a mini-PC. Inputs can be given by three magnetic keys and feedback can be given on a display. For data exchange to a PC system a serial port was used. All parts are integrated into a board and covered water proof. The subject has to push the board in front of his body during the test.

All tests were performed with complete SCUBA equipment. For each routine a specific software module was developed to control the test and to give necessary information to the subject. For the speedtest the subject has to swim under water with maximum speed. Impeller revolutions are counted and the number of counts is stored with 10 Hz. Later evaluation software allows to derive speed, distance and duration of the activity. The step increase in the steptest is pre-programmed: actual speed and target speed are compared and differences are displayed. Time of heart beats and the counts of impeller revolutions are stored and available for off-line analysis.

## P11R-13

**The thermal effectiveness of water sports garments on skin temperature, grip strength and dexterity during cold water immersion****Hencken Clare, Oakley Ben**

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*Keywords: thermal, grip strength*

Maintenance of grip strength and manual dexterity are essential to a number of Olympic water sports (e.g. windsurfing, sailing and canoeing) and their recreational cousins (e.g. water skiing and kite sailing). This is of particular interest to watersports participants who compete in temperate climates where water temperatures are commonly 10 °C. It has already been established that even short-term immersion of the forearm in cold water produces a fall in tissue temperature and a reduction in maximal grip strength in subjects (Vincent & Tipton, 1988). Watersports participants in N. Europe choose to wear wetsuits and rash vests to protect themselves against environmental cooling. However the thermal capacity of such clothing has received little attention. The purpose of this study was to examine the effect of forearm immersion on maximal grip strength and dexterity of 6 individuals across three conditions: bare arm (BA), lycra rash vest (LRV) and wet suit (WS).

6 volunteers aged between 18-22 years gave their consent to participate in repeated measures of 40-minute forearm immersion in 10 °C water. In all three conditions, subjects



were intermittently sprayed with cold water and a wind effect of 3.2ms<sup>-1</sup> was applied using fans. Heart rate, skin temperature and thermal comfort were measured every 2 minutes and grip strength and dexterity tasks were administered every 4 and 5 minutes.

The cold water immersion produced a significant decline in skin temperature across all conditions ( $p < 0.01$ ), however the WS kept the forearm significantly warmer than the BA or LRV ( $p < 0.05$ ). With respect to performance, there was a significant decline in both dexterity and grip strength as immersion time increased. The WS condition also allowed strength and dexterity performance to be maintained at a more productive level for longer when compared to BA and LRV conditions.

Performance markers such as grip strength and dexterity do not show a significant correlation to skin temperature (ST). However the relationship between ST and deep muscle temperature (DMT) is evident. After 20 minutes immersion, DMT reduces to approximately 27°C. This study supports findings by Clarke, Hellon and Lind cited by Vincent and Tipton, 1988, who found that 20 minutes immersion in cold water was a threshold where significant deficits in performance were observed. The thermal property of the WS helped to reduce this performance deficit.

#### P11R-14

### Effects of body building hypertrophy on structure and function of human skeletal muscle

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**Keywords:** *muscle, hypertrophy, MHC*

It is generally accepted that the large functional heterogeneity and plasticity of skeletal muscle depends on changes in mass (muscle atrophy or hypertrophy) and in relative distribution of the different types of skeletal muscle fibres within the muscle itself. Single muscle fibres have very different contractile and energetic properties according to the myosin heavy chain (MHC) isoform they contain. Type 1 fibres (containing MHC-1) have lower maximum shortening velocity ( $V_o$ ), power and ATP consumption than type 2X fibres (containing MHC-2X). Type 2A fibres (containing MHC-2A) are intermediate between type 1 and 2X fibres and hybrid fibres (1-2A and 2A-2X) are intermediate between the corresponding pure fibre types.

In order to assess the adaptive changes of skeletal muscle to a high intensity power training, biopsy samples of the vastus lateralis muscle were collected from body builders (bb) and healthy controls (ctrl). MHC isoform distribution of the muscle samples, size (cross sectional area, CSA), force ( $P_o$ ) and maximum shortening velocity ( $V_o$ ) of identified types of single muscle fibres were determined.

In bb the results showed: a percentage decrease of MHC-1 (the slowest) and a percentage increase of MHC-2X (the fastest and powerful); a selective hypertrophy of fast muscle fibres; a decrease of  $P_o$ /CSA of slow fibres and an increase of  $P_o$ /CSA of fast fibres; a selective decrease of  $V_o$  in slow fibres.

#### P11R-15

### Effect of caffeine ingestion on anaerobic and aerobic exercise

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**Keywords:** *caffeine, Wingate test, Bruce test*

Investigations examining the ergogenic influence of caffeine during short-term high-intensity exercise and short-term endurance performance are few in number and have produced inconsistent results. This study aimed to verify the influence of oral caffeine on anaerobic and aerobic exercise through a supramaximal exercise (Wingate test) and a treadmill test until exhaustion (Bruce test).

Eighteen male untrained and healthy volunteers, non-smokers, and non-consumers or moderate consumers of coffee or other sources of caffeine were selected. Subjects performed two Wingate or Bruce tests at different days: 1 hour after the ingestion of 5 mg.Kg<sup>-1</sup> caffeine diluted in 100 mL of lemon tea, and 1 h after the same tea but without caffeine. Immediately before, and 5 and 30 min after each test, blood lactate and glucose were measured. Heart rate was controlled and urinary caffeine concentrations were also measured for 7 h. Caffeine was measured by HPLC-uv.

The urinary caffeine concentration was always under 12 mg.L<sup>-1</sup> for every volunteer ( $C_{max} = 7.1 \pm 0.4$  mg.L<sup>-1</sup>;  $t_{max} = 1.6 \pm 0.5$  h). In the Wingate test the absolute and relative peak power improved after ingesting caffeine, as did absolute and relative mean power and total work. However, there were no significant differences on the fatigue index and no significant changes were verified on blood lactate. With caffeine, blood glucose was significantly raised at 5 min after each test (compared with the test without caffeine). Regarding aerobic exercise, the time to exhaustion after caffeine significantly increased, as well as the  $V_{O2max}$ . Heart rate was not significantly changed by caffeine in both tests.

In conclusion, ingestion of 5 mg.Kg<sup>-1</sup> caffeine produces a worthwhile enhancement of short-term endurance performance and of anaerobic short-term high intensity exercise in a controlled laboratory setting, in spite of the fact that the urinary caffeine concentrations in all the volunteers were under the legal level permitted by the IOC.

#### P11R-16

### Spleen response to repeated breath-hold apneas

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**Keywords:** *ultrasound, spleen response, repeated apneas*

It is well-known that one may increase the maximal duration of apneic diving by performing several attempts in advance. It is also suggested that the spleen contracts in apneic diving, delivering much of its blood content to active circulation. We hypothesized that the spleen empties continuously throughout the first apnea and does not recover in the short period between the next attempt. If so, the second and following apneas would have an advantage over the first one in having larger circulating red blood cell pool at the onset of apnea.

In order to test this hypothesis, 10 trained apnea divers, 10 intact and 7 splenectomized untrained persons repeated five maximal apneas (A1-A5) with face immersion in cold water, with two minutes interposed between successive attempts.

Ultrasonic monitoring of the spleen and noninvasive cardiopulmonary measurements were performed before, between apneas and at times 0, 10, 20, 40, and 60 minutes after the last apnea.

The duration of apneas peaked after A3, being 143, 127, and 74 seconds in case of apnea divers, intact and splenectomized persons, respectively. A rapid decrease in spleen volume (about 20% in both apnea divers and intact persons) was mainly completed throughout the first apnea, the spleen did not recover in size between apneas and only partly recovered 60 minutes after A5. The well-known physiological responses to apnea diving: bradycardia and increased blood pressure were observed in A1 and were constant throughout the following apneas.

These results show that rapid spleen emptying and its slow recovery may contribute to prolongation of successive, briefly repeated apnea attempts.

#### P11R-17

### Unusual problem with stress fracture in metatarsal osseos in young sportmen

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*Keywords: stress fracture, metatarsal*

Young volleyball player was injured two times in the period of five weeks. Both times he complained the ache of the forefoot (metatarsal region).

After the first treatment on the department of Sports Medicine, the patient felt good. The treatment included resting and analgetic, physical therapy.

After seven days of therapy he returned to full sport activity. Physical treatment continued parallelly with sport activity.

Two days after the second injury (41 days after the first injury) he visited Orthopedic Department where the doctor misdiagnosed it as an old fracture in bad alignment with suspected pseudo arthrosis and forbade physical therapy.

Two weeks since the second injury at regular control with new RTG examination and with comparing the former RTG picture and clinical examination we established a fracture of the second and third metatarsal bones from which the third metatarsal bone fractured on the occasion of the second injury. The fracture of the second metatarsal bone was on the occasion of the first injury (which is evident in carefully examination of the first RTG picture).

The volleyball player began with sports activity two months after the second injury. After one year of follow up, subjectively, clinically and radiographically, the results of treatment were excellent and the patient returned to the same level of sport activity before injuring.

## Poster Session

### Sports Medicine 3 - Health and Fitness 3

**P11S**

#### P11S-01

### The impact of intense training on physical and hormonal maturation of elite male athletes

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*Keywords: training, hormonal maturation, physical maturation*

Puberty in humans is characterized by large hormonal changes resulting in both physical maturation (i.e. skeletal development and growth) and sexual maturation (i.e. growth of pubic hair, and development in the genitalia). Intense training has been found to delay the onset of puberty in females by altering normal hormonal development (Theintz, 1994). This has led to delayed pubertal onset, delayed age at first menarche and failure to develop mature skeletal structure (Malina, 1983). In males, despite evidence that physical activity can also result in hormonal changes, there have been few studies that examined the relationship between training and the onset of puberty. The purpose of this study was to evaluate the effects of intense training on physical growth and sexual maturation in young male gymnasts.

Pubertal development, testosterone levels, energy expenditure and body fat were examined in 21 circum-pubertal male athletes (13.3±0.3yrs) and 24 age-matched controls (13.5±0.3yrs). Subjects completed a self-assessment of genital and pubic development using the Tanner Scale. Testosterone levels were determined from saliva samples. The Aerobics Center Longitudinal Study's

Activity Questionnaire was used to estimate weekly energy expenditure in METs. Percent body fat (%BF) was assessed using bioelectrical impedance analysis.

Developmental stages (DS) and testosterone levels (Ts) were not different between groups. Although the gymnasts were slightly shorter and lighter than the controls, (155.5±2.3 vs. 162.5±1.9 cm and 48.3±2.7 vs. 54.4±1.4 kg respectively) these differences were not significant ( $p>0.05$ ). Energy expenditure was higher ( $p<0.05$ ) in athletes than controls (198.7±6.7 vs. 112.1±4.4 METs) whereas %BF was significantly ( $p<0.05$ ) lower in athletes (8.6±1.0 vs. 13.5±0.2). Energy expenditure was negatively correlated ( $p<0.05$ ) with %BF but not related to Ts. The DS was strongly ( $p<0.05$ ) related to Ts but not to energy expenditure or %BF.

It is concluded that, although the higher energy expenditure accompanying intense training in young male athletes does have an impact on their body composition, it does not appear to have significant effects on pubertal development.

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*In: Competitive Sports for Children and Youth*

*Theintz GE (1994). Clinical Endocrinology, 41: 267*

## P11S-02

**Anthropometric- and age-related values for maximum strength of untrained subjects aged 12 to 80 years****Marchart Petra, Haber Paul**

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*Keywords: strength measurement, untrained subjects*

In the past various strength data obtained from athletes and resistance trained subjects were published, mainly with men as subjects. Few data about measurements and reference values of muscle strength of untrained subjects exist. This study presents values for maximum strength of untrained subjects aged 12 to 80 years as well as multiple regression equations to predict maximum strength from age, sex and anthropometric dimensions individually.

258 untrained and healthy subjects - consisting of 138 young persons (12- to 18-year olds) and 120 adults (20- to 80-year olds) - participated in anthropometric and strength measurements. Maximum strength (One-repetition-Maximum, 1-RPM) was obtained on a dynamometer (Concept 2 Dyno) for three exercises: seated bench press, seated bench pull and leg press.

The highest significant correlations to strength performances showed body surface (BS) and fat free mass (FFM) (kg) ( $r$  between 0,622 and 0,865,  $p < 0,001$ ). Calculated as single predictor variables for maximum strength also BS and FFM (kg) predicted muscle strength the best ( $R^2$  between 0,531 and 0,746). Multiple regression analysis was performed using age, sex, BS and FFM (kg) as predictor variables. In relation to age, sex, BS and FFM (kg) maximum strength of young persons (aged 12 to 18) can be predicted for as much as 79 % ( $R^2$  between 0,671 and 0,789). For adults, maximum strength can be predicted for 83 % ( $R^2$  between 0,715 and 0,830).

The regression equations we fitted make it possible to compare the strength values of persons with the average of the same sex, age, body size, body weight and body fat. The strength values as a percentage of the average permit a comprehensive assessment of the performance with respect to the momentary strength level as well as a documentation of a training or rehabilitation programme.

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## P11S-03

**Histological studies of the mechanical stability of fine wire electrodes in rat skeletal muscle****Tamaki Hiroyuki, Wagatsuma Akira, Ogita Futoshi, Takekura Hiroaki**

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*Keywords: fine wire electrode, muscle fibre, damage*

Electromyography (EMG) is a suitable method to study neuromuscular functions. Intramuscular wire electrode (IWE) for neuromuscular study has a higher spatial resolution of single motor unit activity but IWE induced-muscle damage and mechanical instability can be seen frequently. We observed a mechanical stability and histologically available lead-off area of the IWE in rat skeletal muscle in situ using histochemical techniques.

Single copper wires (50µm diameter) coated with the polyurethane were twined, and three types of electrode, i.e.,

coiled electrode, coiled electrode with suture inside, and straight electrode were prepared. Coiled wire electrode had  $257 \pm 18$  µm of the pitch,  $184 \pm 9$  µm of the inside and  $284 \pm 9$  µm of the outside diameters. Each electrode was inserted into soleus, tibialis anterior, and/or extensor digitorum longus muscles of the adult male Wistar rats. After fixation of the muscles, transversely serial sections (5µm) were cut using a cryostat or microtome and stained with haematoxylin and eosin. A quantitative analysis of microscopic observations was performed utilizing a CCD Video Image Analysis System (Olympus, Japan) and a digitizing system which consisted of a light microscope and a video monitor.

The microscopic observation is showing that the muscle fibers are strongly stuck between the coil pitch. A muscle damaged area (DA) around the electrode's body was significantly ( $p < 0.0001$ ) larger in the coiled electrode (0.05mm<sup>2</sup>) than in the straight electrode (0.01mm<sup>2</sup>). However, no significant difference was observed in the DA (0.003mm<sup>2</sup>) around a recording point at the hook of each electrode. The suture edge at the opposite side of the wire (50µm diameter) directly contacted to the muscle fiber. The average distance between the recording point and the electrode body was over 1mm in all electrodes.

The histological characteristic in the localization of the electrodes might be directly brought about a higher mechanical stability of wire electrode in skeletal muscle. Muscle fibers with no histopathological damage within the radius of 1mm from the leading-off surface would be available for recording the action potential.

## P11S-04

**Lactate reaction after eccentric endurance-exercise****Koller Arnold, Greiderer Brigitte, Pfister Rudolf, Haid Christian, Hörtnagl Helmut**

University of Innsbruck, Austria

*Keywords: lactate, eccentric exercise, concentric exercise*

Recently, Horstmann et al (*Med Sci Sports Exerc* 33:791-5, 2001) concluded that eccentric exercise leads to lower lactate reaction than concentric exercise in comparable work levels.

To investigate this, the total work performed in concentric and eccentric exercise mode were kept comparable by selecting higher angular velocity for the concentric mode (180°·s<sup>-1</sup> [concentric mode] vs. 60°·s<sup>-1</sup> [eccentric mode]). Thus it remains uncertain whether different mode (concentric vs. eccentric) or different angular velocity (180°·s<sup>-1</sup> vs. 60°·s<sup>-1</sup>) is the cause for the difference in lactate reaction. Therefore, 12 men (27.9 ± 5.8 yr, 179.0 ± 7.6 cm, and 71.9 ± 9.7 kg) performed maximum isokinetic 1-min endurance tests of the knee in eccentric (60°·s<sup>-1</sup>) and eccentric (180°·s<sup>-1</sup>) modes. In addition, 13 men (27.5 ± 7.7 yr, 179.0 ± 7.9 cm, 74.5 ± 9.0 kg) performed isokinetic endurance tests of the knee in eccentric (60°·s<sup>-1</sup>) and eccentric (180°·s<sup>-1</sup>) modes in comparable work (5000 Joule). Blood samples for the determination of lactate were taken from hyperemic ear lobe before and directly, 3 and 5 min after exercise.

Total work during an exercise time of 1 min was significantly ( $P < 0.001$ ) higher in eccentric exercise at 180°·s<sup>-1</sup> (8944.6 ± 3683.3 Joule) compared with eccentric exercise at 60°·s<sup>-1</sup> (5214.2 ± 1760.8 Joule). By contrast, exercise time was significantly ( $P < 0.001$ ) lower in eccentric exercise at 180°·s<sup>-1</sup> (29.7 ± 8.5 s) compared with eccentric exercise at 60°·s<sup>-1</sup> (70.7 ± 20.0 s) in comparable work levels. Significant differences ( $P < 0.01$ ) in lactate production (0.71 ± 0.45 mmol·L<sup>-1</sup> [180°·s<sup>-1</sup>] vs. 1.28 ± 0.89 mmol·L<sup>-1</sup> [60°·s<sup>-1</sup>]) were only found in endurance tests with comparable work levels

(5000 Joule). The differences in lactate production ( $1.34 \pm 1.29 \text{ mmol}\cdot\text{L}^{-1} [180^\circ\cdot\text{s}^{-1}]$  vs.  $1.02 \pm 0.85 \text{ mmol}\cdot\text{L}^{-1} [60^\circ\cdot\text{s}^{-1}]$  in the 1-minute endurance tests were not significant ( $P>0.05$ ).

The present study supports the conclusion that eccentric exercise leads to lower lactate reaction than concentric exercise. The lactate reaction in the eccentric form of stress seems to be more dependent on exercise time than on total work performed or angular velocity.

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#### P11S-05

### Kinetics of the heart rate response of patients with chronic chagasic cardiopathy

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**Keywords:** heart rate, exercise, chronic chagasic cardiopathy

The patients with Chronic Chagasic Cardiopathy (CCC) must present injuries in the heart tissue and dysfunction in the nervous system. The purpose of the present investigation was to analyze the kinetic of the heart rate response during exercise and recovery of patients with chronic chagasic cardiopathy, at different degrees of the disease (Los Andes classification).

Thirteen healthy male volunteers ( $36 \pm 9$  years) and 34 patients ( $48 \pm 12$  years) were studied. The patients were divided into 4 groups according to Los Andes clinical/hemodynamic classification: IA (both normal ECG and ECO;  $n=13$ ;  $43 \pm 8$  years); IB (normal ECG and abnormal ECO;  $n=8$ ;  $49 \pm 16$  years); II (abnormal ECG and ECO, without congestive heart disease-CHD;  $n=7$ ;  $50 \pm 11$  years) and III (abnormal ECG and ECO with CHD;  $n=6$ ;  $56 \pm 10$  years). The exercise test was done in a mechanically braked ergometer (Monarch, 60 rpm) with increase of  $12.5 \text{ W}\cdot\text{min}^{-1}$  and its duration was symptom limited. The heart rate was observed and recorded during the entire test. The kinetic of the heart rate response during the exercise and in the recovery period (first 3 minutes) were analyzed by observation of the  $T \frac{1}{2}$  (50% of time of the analyzed curve). The comparison among the groups was made with ANOVA and Tukey honest test, and the adopted level of significance was  $p<0.05$ .

This study showed that there are no statistical significant differences for the  $T \frac{1}{2}$  during exercise, although there are different medium responses of heart rate between the 2 groups studied. During the recovery period, the kinetic of the heart rate presents statistical differences according to the degree of the diseases development (III is not IA,  $N$ ;  $p=0.045$ ).

The results showed a different heart rate kinetic among patients with a high degree of the diseases development (III Group) and the other analyzed groups. This result must be explained by the loss in cardiac-hemodynamic and nervous system performance of the patients with a high degree of the diseases. The recovery period was slowly following the loss in cardiac-hemodynamic performance of the patients. The  $T \frac{1}{2}$  at the recovery point out to be good parameters to distinguish the response of the heart rate of the patients with chronic chagasic cardiopathy.

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#### P11S-06

### Eyewear and ocular protection patterns of cricket players

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**Keywords:** ultraviolet radiation, sunglasses, hats

A research project is currently underway to investigate the ocular protection patterns of cricket players. Cricket is a sport played under conditions of high solar illumination for prolonged periods of time. Participants and players are therefore exposed to high levels of ultraviolet radiation (UVR), which has the potential to cause ocular damage. Associated exposure to visible light leads to glare being experienced and the potential development of visual fatigue and discomfort. These may adversely affect sporting performance. Ophthalmic forms of ocular protection, for example sunglasses, and non-ophthalmic forms, for example hats, are utilised in order to reduce light at the ocular surface. The goals of the study are to: (1) identify the frequency of use of these ocular protective devices and (2) establish the motivation behind the selection of these devices.

The results suggest that ophthalmic (in the form of sunglasses) and non-ophthalmic (in the form of hats) ophthoprotection is generally not favoured by cricket players. Light grey and dark grey tints are favoured by those players wearing sunglasses, with the main reasons for wearing sunglasses being the reduction of glare and protection against UVR. Personal preference for colour and brand are the main reasons for selection of lens tint. Peaked caps are generally preferred to broad-brimmed hats. When surveyed concerning their opinions on ocular photoprotection during sport, all players were in agreement that good vision is important for sports participants.

The majority of respondents indicated that it is important to protect the eyes from the adverse effects of UVR. There is a distribution of opinions concerning the use of sunglasses to achieve ocular comfort.

#### P11S-07

### Relationship of tissue oxygenation kinetics with blood lactate levels and integrated electromyogram values during incremental handgrip exercise

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**Keywords:** near infrared spectroscopy, tissue oxygenation, incremental exercise

When the tissue oxygenation is observed by a near infrared spectroscopy (NIRS) device during ramp load exercise using a bicycle ergometer, there is a linear decrease accompanying load increase in the initial phase of exercise when the load intensity is relatively low. However, the decline in muscle oxygen level reaches a NIRS threshold (NT) in the later phase of exercise when the load intensity becomes high. Beyond the NT, the level plateaus even the load intensity increases. While the phenomenon of NT has been reported in previous studies, its mechanism has not been elucidated. To investigate whether NT appears during exercises other than the ramp load exercise using a bicycle ergometer, we examined the NT phenomenon in incremental handgrip exercise. To study the physiologic significance of NT, we also

examined the relationship of NT with blood lactate and integrated electromyogram values.

Twelve healthy male subjects (age,  $28.3 \pm 9.7$  years) were studied. With the subject in a sitting position, the NIRS probe was attached on the flexor digitorum superficialis muscle of the right forearm. Incremental handgrip exercise was performed with 5% load increment per min starting from a load intensity equivalent to 5% of the maximum muscle strength, and the exercise was continued until exhaustion. The pace of exercise was 20 times per min, and the relaxation ratio of the exercising muscle was 1: 1. Blood was collected from the right antebrachial vein every min during exercise for blood lactate measurement. Integrated electromyogram was also recorded during exercise.

In the exercising flexor digitorum superficialis muscle, the tissue oxygenation decreased accompanying load increase, and NT (MVC,  $34.2 \pm 5.6\%$ ) was observed during the later half of exercise in 12 of 12 subjects. The lactate threshold (LT) and the fatigue threshold (FT) determined from integrated electromyographic analysis were observed at MVC  $33.2 \pm 6.2\%$  and  $34.6 \pm 6.2\%$ , respectively. NT, which is the point at which the tissue oxygenation stops declining, reflects the point at which the rate of deoxy-Hb increase becomes stationary, suggesting an increase in dependence on energy-yielding by anaerobic glycolysis after NT appearance. Therefore, NT was considered to be the initiation point of recruitment of type II-b fibers that yield energy with no need of oxygen when the load intensity increases.

#### P11S-08

### Physical and physiological factors associated with success in professional alpine skiing

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**Keywords:** alpine skiing, aerobic power, muscle strength

The demands of professional skiing are manifold and require special abilities. In comparison to other kinds of sports little is known about the typical anthropometrical, physical and physiological features of professional alpine skiers (Piper 1987; Spring & Jordan 1994). It was the objective of this study to describe the physical and physiological characteristics essential for success in professional alpine skiing.

During the last decade the Austrian Ski Federation disposed of the world's most successful ski team. Between 1997 and 2000 all female and male Austrian World Cup skiers were investigated twice to three-times a year and retrospectively analysed with respect to their anthropometrical profile and capabilities in endurance and strength.

Between 1997 and 2000 about half (48%;  $n = 106$ ) of all racing events in the Alpine World Cup ( $n = 221$ ) was won by the athletes investigated ( $n = 48$ ). The typical world class skier is in the mid-twenties (female = 25.2 yr; male = 27.6 yr) and of moderate to heavy weight (female = 65.1 kg; male = 87 kg) with an average percentage of body fat (female = 24.5%; male = 15.8%). He/she disposes of a muscular physique of average to large height (female = 1.66 m; male = 1.81 m) providing the advantages of grand leverage combined with optimal power. The average maximal power output amounts to  $4.3 \pm 0.4$  and  $4.7 \pm 0.4$  W/kg in females and males respectively, the corresponding values of VO<sub>2</sub>max lie between  $55 \pm 3.5$  and  $60 \pm 4.7$  ml/kg/min. In male specialists a positive correlation was found between

Wmax ( $r = 0.947$ ;  $p = 0.001$ ) and VO<sub>2</sub>max ( $r = 0.964$ ;  $p < 0.001$ ) and the racing results achieved. The maximum mean values of peak torque and work amounted to  $206 \pm 21$  Nm and  $2690 \pm 364$  J in females and  $334 \pm 43$  Nm and  $4414 \pm 629$  J in males. The hamstring/quadriceps ratio was very balanced in both sexes and major laterality did not exist. However, there were marked differences in the anthropometrical profile as well as in the endurance and strength abilities between the sexes, but none between specialists and allrounders.

The study affirms the practical experience that success in alpine skiing is depending on several variables and cannot be predicted from the athlete's laboratory parameters only. Two main factors, however, i.e. high levels of aerobic power and of balanced muscle strength, appear to be indispensable for a successful performance in professional alpine skiing.

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#### P11S-09

### Relationship between maximal oxygen uptake and maximal heart rate during four modes of exercise

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**Keywords:** modes of exercise, maximal heart rate, maximal oxygen uptake

The purpose of the present study was to compare %HRmax values, predicted from regression equations %VO<sub>2</sub>max-%HRmax. The linear regressions were performed with %VO<sub>2</sub>max as independent variable and %HRmax as dependent variable, from data collected during graded exercise until exhaustion in four exercise modes: cycle, rower, stepper and treadmill.

Ten active young adults males and ten females, apparently healthy for the risk factors of cardio-vascular disease were trained on each mode of exercise and then performed an incremental test to maximum on each mode. Mode order was assigned at random sequence and the tests were separated by at least 72 h. VO<sub>2</sub> and HR were recorded at each 10 seconds. Regression analyses and repeated measures ANOVA were performed using SPSS 7.

Concerning women's group, rower had a higher intercept and lower slope, while stepper had lower intercept and higher slope. Concerning men's group, cycle had higher intercept and lower slope and stepper had lower intercept and higher slope. In order to compare predicted %HRmax values, linear regressions %VO<sub>2</sub>max-%HRmax were performed for each subject. From these regressions, target values of %HRmax were computed for each individual. There were significant differences between cycle and treadmill and between stepper and treadmill in women's group and between cycle and treadmill in men's group.

These results suggest that weight bearing exercise modes (stepper and treadmill) have different regression equations than weight supported and arm exercise modes (cycle and rower).

## P11S-10

**Echocardiographic evaluation of morphology and left ventricular function in active sportsmen (wrestlers and footballers)**

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*Keywords: athletic heart, wrestling, left ventricular function*

Wrestling is a sport which can be characterized by intensive and shorttermed physical, isometric above all, effort, while football is characterized by longtermed physical isotonic effort. The dominant compensatory cardiologic mechanism with both groups of sportsmen is left ventricular hypertrophy. The aim of this study is the evaluation of morphology and left ventricular function of the group of wrestlers and footballers in the period of competition time and their interactive comparation. The septum wall and the posterior wall thickness, enddyastolic and endsystolic volumen, ejection fraction and left ventricular mass (LVM) have been evaluated.

The research was conducted at the Institute of Cardiovascular diseases in Sremska Kamenica and at the Institute of Sportmedicine-Medical Faculty in Novi Sad, Yugoslavia. Echocardiographic examination was done on all the patients by using transtoracal approach. 50 wrestlers were examined, average age  $23 \pm 1.8$  years, and the time of their active sports life is  $12 \pm 1.6$  years. In addition to this, 50 footballers average age  $24 \pm 1.9$  years with  $13 \pm 1.4$  year of active sports life.

Septum wall thickness in wrestlers was  $14.52 \pm 1.3$  mm, and in footballers  $11.21 \pm 1.4$  mm. Posterior wall thickness in wrestlers was  $14.54 \pm 1.2$  mm and in footballers  $11.29 \pm 1.2$  mm. Enddyastolic volumen in wrestlers' group was  $95.13 \pm 11.13$  ml, and in footballers' group  $128.37 \pm 12.64$  ml. Endsystolic volumen was  $35.86 \pm 5.25$  ml in wrestlers' group, and in footballers' group  $38.64 \pm 8.12$  ml. Left ventricular ejection fraction in wrestlers was  $65.00 \pm 4.64$  %, and in footballers  $70.00 \pm 5.01$  %. Left ventricular mass index in wrestlers was  $168.4 \pm 9.32$  gr/ m<sup>2</sup> and in footballers  $148.35 \pm 9.46$  gr/m<sup>2</sup>.

Septum and posterior wall thickness has been established in both sports groups, but thickness is statistically more significant in wrestlers. In footballers the statistically significant enlargement of enddyastolic left ventricular volumen has been found compared to normal values and compared to enddyastolic volumen in wrestlers. In both groups endsystolic volumen does not change significantly compared to normal values. Left ventricular ejection fraction is expectedly high in both groups, however it is higher and statistically significant in the footballers' group. Left ventricular mass index is statistically increased in both groups, but it is higher in the wrestlers' group.

## P11S-11

**Safety measures of golf course**

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*Keywords: golf, accident, ambulance calls*

We have identified the actual state of accidents and emergency medical services in golf courses in Germany and Austria through questionnaire surveys. In order to survey the safety situation of golf courses in Germany and Austria, we sent out questionnaire to 629 golf courses in the above nations to learn about their present condition of accidents and emergency medical services.

Postal questionnaire consisted of the following main items:

- 1) The number of ambulance calls by month and their reasons during the period from Jan. to Dec. 2000,
- 2) The number of player-involved accidents during the above period,
- 3) Specific examples of emergency medical services,
- 4) The active emergency medical service system in your golf course.

The total number of having answered in the questionnaire was 73 golf courses (11.6 %). There were 34 golf courses (46.6 %) which experienced the ambulance calls. The number of ambulance calls was highest in the summer season, from July to September.

As for fatal accidents that involved players, five cases of such accidents were reported by five golf courses. There was one golf course experienced any accidents caused by lightening. Totally, 79 fatal accidents were reported from 17 golf courses (23.3 %) that they had experienced accidents, which required surgical treatment, while 53 golf courses reported they had never had.

On the emergency medical service system, the number of golf courses that answered "yes" to the question "Do you have any partnership with neighboring hospitals or other medical facilities?" was 64 (87.6 %), while 9 places answered "no."

The number of golf courses that answered that they had a person(s) responsible for the emergency response in case of accidents within their premises was 24 (32.8 %), while 50 (68.4 %) said they do not. As for the availability of qualified personnel to conduct emergency medical treatment, 22 places (30.1 %) answered that they have such persons available, while 48 (65.7 %) said they are not. The types of qualified medical staff were doctors at 8 golf courses and others at 21 courses.

## Poster Session

## Sports Medicine 4 - Health and Fitness 4

P11T

## P11T-01

**Determination of aerobic fitness in obese adults: comparison of a lab and field test method**

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**Keywords:** aerobic fitness, testing, 2km walk test

It has been demonstrated that a high cardio-vascular fitness level (CRF) reduces the all-cause mortality in obese people (BMI >27) to that of normal weight adults (Barlow et al. 1995, Lee et al. 1998). Endurance type exercise is often recommended in weight management programmes for improving CRF (Novartis Nutrition GmbH 2000, Wallace 2003). The change in CRF can be demonstrated by determining oxygen uptake (VO<sub>2</sub>) with certain tests. The 2-km walk test is a feasible method predicting peak VO<sub>2</sub> in overweight healthy people (Laukkanen et al. 1992). We hypothesize that the 2-km walk test will give a valid estimation of CRF expressed as VO<sub>2peak</sub> compared to a laboratory walk test in obese adults.

12 obese adults (50.2±9.6yr, 90.5 ±9.1kg, 34.1±3.5BMI, 41.7±6.3% fat) got familiar with the UKK-walk test and an ergo-walk test on the treadmill. The participant completed the 2-km walk test according to the recommendations described in the Tester's guide of the UKK-walk test (UKK Institute 2002) after trying the procedure 2 times on separated days. Peak oxygen uptake was predicted using the UKK-Walk test software for males and females. Within the same week, 2 days separated from the 2-km walk test, the ergo walk was carried out on a treadmill with changing velocity and incline based on the modified Pennsylvania State protocol (Kukkonen-Harjula et al. 1998). A breath-by-breath spirometer (Cosmed, K4b2) was used to measure VO<sub>2</sub>. The VO<sub>2peak</sub> was determined in the last bout as the average of ±3 steps of the peak value. Validity of the 2-km walk test was determined with correlation analysis and with T-test for paired samples.

Measured VO<sub>2peak</sub> with 28.9 (6.5) ml min<sup>-1</sup> kg<sup>-1</sup> was not significantly different (p=.104) from the estimated value of 23.9 (6.8). A significant correlation was found between the two test procedures (p=.038, r=0.628) in 12 obese subjects.

The predicted cardio-respiratory fitness expressed as peak oxygen uptake of subjects with a BMI of 34 kg m<sup>-2</sup> correlates well with the measured one. The correlation coefficient is lower than reported by Laukkanen et al. (1992, r=0.77/0.75). We conclude that the CRF of obese people can be evaluated with the UKK-walk test for screening. But it has to be emphasized, that the 2-km walk test under-estimates the VO<sub>2peak</sub> as reported by Oja et al. (1991).

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## P11T-02

**Dynamic in vitro comparison of fixation methods used in ACL reconstruction**

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**Keywords:** ACL, graft, fixation

One important factor for the success of ACL reconstruction is a secure graft fixation. The purpose of this study was to determine the initial mechanical properties prior to remodelling of common fixation methods of Bone-Patellar Tendon-Bone (BPTB) grafts.

Three different fixation methods for BPTB grafts (Endobutton, Interference Screw, Suture-Post Fixation) were compared under failure tensile loading versus cyclic sub-maximal tensile loading using 48 human cadaver knees and a material-testing machine.

No difference in ultimate load between the three techniques was observed (p=0.47). Stiffness of the BPTB grafts was significantly lower for the suture techniques than for the Interference Screw (p<0.001). Cyclic loading revealed statistically significant different failure rates: 0% of the Endobutton, 38% of the Interference Screw and 100% of the Suture-Post Fixation group failed during the cyclic test. The relative movement of the femoral bone plug and the migration of the bone plug out of the femoral canal were lowest in the Interference Screw group.

The Suture-Post Fixation is not recommended. The Interference Screw showed the best results. However, for the Interference group the results were age dependent, suggesting its best use in younger patients; in older patients the Endobutton may offer certain advantages. A pretensioning of the reconstruction during operation is important to reduce loosening and relative movement especially in the Endobutton technique.

## P11T-03

**Non contrast-enhanced perfusion imaging for exercised muscle using flow-sensitive alternating inversion recovery (FAIR) sequence**

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**Keywords:** MRI, muscle perfusion

In conventional magnetic resonance imaging (MRI), T2 relaxation time is used for quantification of intramuscular water content. However it is impossible to separate an inflow blood signal from intramuscular water content. Recent MR technology allows clinical application of flow-sensitive

alternating inversion recovery (FAIR) sequence, which has been carried out as a non contrast-enhanced perfusion imaging of the lung. The aim of this study was to apply FAIR sequence to examination for acute perfusion change on exercised muscle.

This study comprised five healthy volunteers (3 male and 2 female) ranging in age from 21 to 40 years. MR imaging was performed with a 1.5T superconducting MR imaging system (Gyroscan, Philips Medical Systems, Netherlands) with a knee coil. FAIR and spin echo sequences to obtain transverse axial image performed dynamically to all subjects. FAIR sequence was used with a repetition time (TR) of 2154 ms, an echo time (TE) of 14.5 ms, flip angle (FA) of 90 degree, and inversion time (TI) of 1500 ms. Spin echo sequence to obtain T2-weighted image was used with a TR of 3000 ms, a TE of 20, 40, 60, and 80 ms, FA of 90 degree. The matrix size of both sequences was 128 by 256 for a rectangular field-of-view of 200 mm. T2 relaxation time was calculated from T2-weighted image with four different TE. Total time required to acquire 23s for FAIR sequence and 2min 36s for spin echo sequence. Serial dynamic MR images were obtained before and immediately after exercise. The volunteers performed isotonic ankle dorsiflexion exercise with 30%1RM load until exhaustion. The evaluation was performed with visual analysis between FAIR and T2-weighted images, and with signal intensity (SI) rate between SI of FAIR images and T2 relaxation time.

FAIR subtraction images depicted acute contrast change especially in the tibialis anterior muscle. However, flow-sensitive images and T2-weighted images could not show this change. Maximum SI rate increased by 203.5±20.95% (FAIR subtraction images), 110.6±3.52% (flow-sensitive images), and 142.2±1.91% (T2 relaxation time), respectively. Maximum SI rate of FAIR subtraction images were significantly higher than flow-sensitive signal intensity and T2 relaxation time ( $p<0.05$ ).

FAIR subtraction images well depicted acute flow change in exercise muscle. Our results suggested that FAIR sequence was a promising method to evaluate muscle perfusion without contrast media.

#### P11T-04

### Does critical swimming velocity represent exercise intensity at maximal lactate steady state in adolescent swimmers?

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**Keywords:** critical velocity, adolescent swimmers, maximal lactate steady state

Critical velocity (CV) has been used as a noninvasive method to estimate the corresponding velocity to anaerobic threshold (4 mM) in children and adults (Grecco et al., 2002; Wakayoshi et al., 1992). However, adolescents and children seem to present lower values for blood lactate in response to exercise when compared to adults (Williams & Armstrong, 1991). Thus, the purpose of this study is to investigate if CV effectively corresponds to Maximal Lactate Steady State (MLSS) in adolescent swimmers.

Six male swimmers ( $15.2 \pm 0.4$  years; body mass  $58.0 \pm 7.5$  kg; height  $170.0 \pm 5.6$  cm) were submitted to swim three different distances (50, 100 and 200 m) crawl style at maximal effort, one event was swum per day in random order. The CV was defined by the inclination (b) of the linear

regression line between distances and their respective times. For the definition of MLSS, the subject performed three tests (5 x 200 m) with a 24 h interval in randomized order in the velocities corresponding to 98 %, 100 % and 102 % of CV, with a 30 second pause between the 200 m for collection of blood sample and lactate analyses at the end of the first, third and fifth 200 m. For statistical treatment used two-way repeated measures analysis of variance (ANOVA).

The CV was  $1.22 \pm 0.10$  m.s<sup>-1</sup>. In the intensity corresponding to 98 % of CV a difference between the lactate concentration was found between the first and the third 200 m ( $1.95 \pm 0.51$  vs  $2.62 \pm 1.07$  mmol.l<sup>-1</sup>;  $P<0.05$ ), but no difference was found between the third and fifth 200 m ( $2.62 \pm 1.07$  vs  $2.65 \pm 0.99$  mmol.l<sup>-1</sup>;  $P<0.05$ ).

For the intensities of 100 % and 102 % a difference in lactate between the first and the third, and a difference in lactate between the third and fifth 200 m ( $P<0.05$ ) were found. The lactate concentration in the first, third and fifth 200 m was greater in the intensities of 100 % and 102 % than in the 200 m corresponding to 98 % of CV ( $P<0.05$ ). Accordingly, the lactate concentration in the intensity corresponding to 102 % of CV was greater in the first, third and fifth 200 m than in the intensity of 100 % of CV ( $p<0.05$ ). This study demonstrates that the existence of a dynamic balance in the 200 m performed at intensity corresponding to 98 % of CV and the accumulation of lactate in superior intensities seem to be an indicator that this index does not reflect the intensity corresponding to MLSS in adolescent swimmers.

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#### P11T-05

### Examination of the shoulder in adolescent swimmers

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**Keywords:** swimming, shoulder, range of motion, kinetics

The purpose of this study was the examination of the movements of the shoulder in order to establish the early signs of a swimmer's shoulder.

The subjects were 7 boys ( $13 \pm 1.15$  years old) and 13 girls ( $13 \pm 1.22$  years old). All subjects were participating in this study voluntarily with written informed consent of their parents. The "swimming age" of the participants was  $7.3 \pm 2.8$  years. They had no complaints about shoulder pain during their regular training, normally 15 hours per week. After completing a questionnaire about the medical history of the subjects, we made a complete physical examination. The physical examination included inspection, palpation, and evaluation of range of motion of the glenohumeral joint. In addition, we used different provocative tests (Neer's test, Hawkins' test). Pain elicited with these manoeuvres was regarded as a sign of subacromial impingement. The maximum isometric strength of the external and internal rotator muscles was measured by an appropriate dynamometer. The swimming movements were recorded by underwater video cameras. The data were analysed by 2D DLT (APAS free version). We used descriptive statistics, ANOVA, and Chi square test for statistical analysis of the data.

Apart from the common children's diseases, no noticeable illness was mentioned neither by the subjects nor by their parents. Ten subjects felt pain during the provocative testing, while the others (eight subjects) were physically fit. The



analysis of the swimming technique showed that all subjects were well trained. We found no significant differences in the range of motion between the subjects having pain and the others. The analysis of the maximum isometric strength of the rotators showed no significant differences between the right and the left side. In contrast, the internal rotators were stronger than the external rotators on both sides. Furthermore, the internal rotators were significantly stronger in the group performing painful effort during the provocative tests than in the effortless group.

The present data indicate that the overuse of the rotator muscles produce the early sign of swimmer's shoulder.

#### P11T-06

### Physical activity level according to chronological age in a state of 36 million people

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*Keywords: health, physical activity levels, promotion*

In 1996 an intervention program to promote physical activity (PA) was launched in the state of São Paulo-Brazil which has 36 million inhabitants, distributed in 645 cities. The program has been evaluating its impact by doing regular PA surveys in the state population. Thus, the purpose of this study was to estimate current PA prevalence of that population, according to chronological age.

In July 2002, a home-interview approach was applied to 2000 persons (953 males and 1048 females) living in São Paulo State, older than 15 years old. Sample was randomized by gender, age, socio-economic and educational status. Groups were divided into: 15-29; 30-49; 50-69; and >70 years old. Subjects were asked about frequency and duration of vigorous (VPA) and moderate physical activities (MPA), and walking, using the international physical activity questionnaire (IPAQ-version 8) short - last week form. The PA level was divided in 5 groups considering the following criteria: a- Very active: vigorous physical activity  $\geq 5$  d.wk<sup>-1</sup>,  $\geq 30$  min per day; or vigorous  $\geq 3$  d.wk<sup>-1</sup>,  $\geq 20$  min per day + moderate activity and/or walking:  $\geq 5$  d.wk<sup>-1</sup>,  $\geq 30$  min per day; b- Active: people who met the current CDC/ACSM physical activity guidelines: vigorous physical activity: 3 d.wk<sup>-1</sup>, 20 min per day; or moderate activity: 5 d.wk<sup>-1</sup> 30 min per day; or walking 150 min.wk<sup>-1</sup>; or an accumulation of 150 min.wk<sup>-1</sup>, 5 times per week of VPA, MPA and/or walking; c- Irregularly active: subjects below the recommendation were considered irregularly active in two groups: A= people who reached one of the criteria of PA recommendation regarding frequency (5 times/week) or duration (150min/week) or B= people who did not reach any criteria of the recommendation; d- Sedentary: no report of PA during last week.

Results evidenced that: a- Prevalence of active people across ages ranged from 47.5% to 56.3%, and irregularly active varied from 36% to 39.7%; b- a negative association it was observed between PA and chronological age only in very active and sedentary categories (increase of 60% in the number of sedentaries in the group over 70 years old); c- considering active and irregularly active, level of PA was quite similar in different age groups; and d-it is important to emphasize that the percentage of people insufficiently active increased from 44% in the younger group to 53% in the older one. We concluded that the involvement with irregular and regular PA seems to do not change with chronological age.

#### P11T-07

### Body fat size and distribution at highly trained male volleyball players

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*Keywords: body composition, body fat, volleyball*

The aim of this study was to evaluate and compare body fat size and distribution of highly trained male volleyball players and non-athlete males.

The experimental group were consisted of 12 highly trained male volleyball players (mean age  $22.33 \pm 4.29$  years), the control group were consisted of 30 non-athlete males (mean age  $20.13 \pm 0.68$  years). The following anthropometric measurements were performed with all subjects' body weight, body height, waist circumference, hip circumference, thigh circumference and sagittal abdominal diameter (SAD). Body mass index (BMI), waist-to-hip ratio, waist-to-height ratio, thigh-to-height ratio, SAD-to-height ratio and SAD-to-thigh ratio were calculated. Body fat percent (FAT%), body fat mass (FATkg) and lean body mass (LBMkg) were estimated using bioelectrical impedance method (Tanita Japan).

According to our results, male volleyball players were normal weight, whereas 16.67% of non-athlete males were underweight, and 26.67% were overweight. Male volleyball players had significantly lower BMI and higher LBM comparing with non-athlete males (FAT%:  $15.54 \pm 2.08\%$  vs.  $18.86 \pm 3.14\%$  and LBMkg:  $76.93 \pm 3.91$  vs.  $64.51 \pm 6.90$  kg). 25% of male volleyball players and 10% of non-athlete males had lower values of body fat (<14%) and 26.67% non-athlete males had higher values of body fat per cent (>20%). Body mass index was the best predictor of body fat size at athlete subjects ( $r=0.923$ ). Regarding to body fat distribution parameters, SAD-to-thigh ratio had the best correlation with FAT% in all experimental group. Waist-to-height ratio had the best correlation with FAT% in the control group.

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#### P11T-08

### Effects of strength training on isometric and dynamic strength, functional and balance capabilities in middle-aged and older women

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*Keywords: strength training, elderly, functional abilities, balance capabilities*

Muscle strength (MS) has been shown to contribute to many tasks of daily life (Bassey et al. 1992). One of the major causes of disability in the elderly comes from aging related reductions in MS (Era et al. 1985). However, progressive strength training (ST) can lead to increases in MS and muscle mass (Häkkinen et al. 1998). This study investigated effects of ST on isometric and dynamic MS, functional (FC) and balance (BC) capabilities in aging women.

A group of 48 women were divided in two age groups: middle-aged (MI n=26) and older (O n=22). Both groups (BG) performed supervised ST two times a wk for 21 wks. MS was measured by bilateral 1RM leg press [kg] (1RM), maximal isometric leg extension [N] (ISOMax) and average

force produced in 0-500 ms [N] (F0-500). FC were measured by 1-legged standing time [s] (1-LEG), 10m walking time [s] (10WALK) and with normal speed [s] (10WALKN), 10 steps stair climbing time [s] with the load of 5,2kg in both hands (10STEPL). Balance was measured using a force platform method (Metitur® Good balance), by three standardized static standing positions keeping eyes open and closed (SP) and in the standard position by dynamic test distance [mm] (DYN.D).

In FC O showed lower values than MI at base-line. 1RM, ISOMax and F0-500 increased significantly during the training in BG. 1-LEG increased slightly in BG. 10WALK and 10WALKN shortened significantly in BG. No changes occurred in 10STEPL in BG. Significant age related differences were observed at baseline in most of the SP variables, but neither of the groups showed training induced changes. DYN.D decreased significantly in BG. 10STEPL correlated with all MS measures in BG at 0 to 21 wks. 1RM and ISOMax correlated with 10WALK at 0 to 21wks reaching significant values at 0wk in MI and at 10.5wk in O. Only F0-500 correlated with DYN.D in O at 21wk.

The present data indicate that maximal and explosive strength characteristics were similarly trainable in BG and were associated with improvements in 10WALK, 10WALKN and in DYN.D. Absolute MS variables did correlate with FC measured in the study. The data further indicate that in aging healthy women also other factors in addition to the increased explosive force of the leg extensors might explain dynamic balance capacity as recorded in the present study.

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#### P11T-09

### Body fat mass and menstrual disorders at female ballet dancers

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**Keywords:** body composition, menstruation, ballet

Female athletes, especially ballet dancers, experience a high incidence of menstrual abnormalities. The aims of this study were to determine the frequency of menstrual disorders and to examine the relationship between body fat mass and menstrual disorders at female ballet dancers and non-athlete females.

The study group consisted of 30 professional and student ballet dancers (average age 17,4±2.01 years). The control group consisted of 30 non-athlete females (average age 18,0 years). Body weight and body height were measured and body mass index (BMI) was calculated for each subject. Body fat mass (FAT%, FATkg) was estimated using a bioelectrical impedance method. A questionnaire was used to obtain the age at menarche, the duration of a menstrual cycle and the duration and intensity of menstrual bleeding.

According to our results, body fat mass was significantly lower at ballet dancers compared to the control group (18.85±4.50 vs. 23.41±4.34%). Amenorrhea accrued at 20% of ballet dancers, whereas 10% of ballet dancers had oligomenorrhea. Ballet dancers tended to have delayed menarche, a menstrual cycle duration over 30 and 60 days, a shorter duration of menstrual flow and scanty or excessive menstrual bleeding, compared to non-athlete females.

Our results also show the presence of a significant negative correlation between duration of menstrual cycle and FAT% at ballet dancers ( $r=-0.415$ ). To assess health risks,

it is very important to evaluate body composition of ballet dancers.

#### P11T-10

### Quality control in the Flemish fitness industry: a survey

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**Keywords:** fitness, survey

The fitness market in the Flemish part of Belgium is a growing industry recognising the need for an organised quality control system. The aim of the present study was to make an inventory of quality related items present in the Flemish fitness industry

463 The fitness market in the Flemish part of Belgium is a growing industry recognising the need for an organised quality control system. The aim of the present study was to make an inventory of quality related items present in the Flemish fitness industry

463 fitness clubs were contacted of which 127 volunteered to take part in the survey. A closed questionnaire was used during an interview on location with the owner/manager of the centre. Observations concerning the infrastructure and material were scored on a 6 point scale.

Most of the managers (n=80) have a management related degree without qualifications in physical education, physiotherapy or fitness. More than half of the employees (177 out of 300) have a degree in physical education or physiotherapy while a significant number of them holds a qualification obtained in another country.

74 % of the managers stimulate their employees for additional training. Evolutions in the fitness world are closely followed by means of subscription to fitness journals (87% of the respondents) and/or the use of internet (62%). The managers pay particular attention on their employees (present in 102 of the 127 fitness clubs) with daily (n=68) or weekly control (n=21). Almost all clubs (97%) evaluate the physical activity readiness of the clients during the intake session. The majority of the clients (111 out of 127) found the initiation during the start of their program very good while only 16 of them reported "sufficient" for the initiation program. Most of the customers rated the quality of the instructions and the offered programs good to very good. The quality of the offered accommodation and equipment received in most of the cases (80%) the score good to very good. Safety measures were not optimal with an insufficient score for the status of the first aid kit (n= 41; 32%), the staff CPR training (n=61; 48%) and the presence of an emergency evacuation plans (n=87; 68%).

Our survey indicates qualitative staff, accommodation and equipment in the screened fitness clubs. Improvement is required concerning the safety measures. However, one should keep in mind that we did not work with a random sample and qualitative strong clubs might have been more likely to participate compared to qualitative weak clubs.

#### P11T-11

### Physical activity of grammar-school youth

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**Keywords:** physical activity, leisure-time, healthy lifestyle

The main aim of the survey is to recognize and analyze the physical activity of grammar-school children aged 14-16.

Researches have tried to find answers to the following questions: 1. Which factors influence physical activity of young people aged 14-16? 2. Which forms of physical activity are prevailing? The survey carried out in the year 2001/2002 in 100 grammar-schools chosen at random and located in the towns of Opole province and Silesia region. 3630 pupils (58,5% boys and 41,5% girls) were subject to a thorough examination. The method of diagnostic sounding was used along with an inquiry technique.

A very important issue connected with leisure time is the way it is spent. It was noticed that passive forms of spending leisure time dominated among the surveyed youth, no matter what their sex was.

Girls preferably watched TV, boys used a computer. Despite numerous positive changes in the way of spending leisure time, there still exist some obstacles limiting the participation of school youth in forms of active relaxation. In opinions of girls as well as boys, the lack of time caused by a huge load of learning is viewed as one of the most serious obstacles. To practice physical activities, apart from school classes of physical education, the greatest number of the surveyed spend 1-2 hours a week. The most frequently and preferably, teenagers do exercises in a company of their friends. The popularity of particular activities in which teenagers participate varies according to their sex. Boys prefer team games (every second one chooses football). Girls, the most preferably participate in gymnastics and modern dancing. Regardless the sex of the surveyed, they are motivated to do physical exercises by: developing their fitness, their will to acquire new or develop their motorial skills, a good way of spending their leisure time in a company of their peers. Contracts with peers should be regarded as efficient and natural ways of encouraging the youth to participate in physical exercise.

A modern Polish school and parents should pay more attention to physical activities of their children and shape their habits of a healthy lifestyle. With the help of environments acting beyond schools, they should do their best to create various possible offers of such activities, taking into account individual interests of the youth.

#### P11T-12

### Severe training induces changes in cortisol and free testosterone levels in elite soccer players

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*Keywords: fatigue, testosterone, cortisol*

The response of plasma cortisol to acute exercise depends critically on the intensity of the stimulus. Severe training stimulation results in an elevation of plasma cortisol. Changes in the circulating cortisol response to exercise and after physical training remain controversial. The long-term effect of exercise on the male hypothalamo-pituitary-gonadal axis is poorly studied. Several studies have found, small, but in some cases significant, decreases in men levels of free testosterone, induced by intense training.

The aim of the study was to investigate the changes observed in the cortisol, free testosterone and testosterone/cortisol ratio, in highly trained soccer players, considering two different specific training periods preparatory and competitive.

Eighteen highly trained male soccer players participated in this study. Before and after each specific training period, blood samples were collected from an antecubital vein. All the samples were collected in the morning period, after waking-up, prior to exercise in a pre-prandial situation. Free testosterone and cortisol were assayed by RIA. During each training session, heart-rate - continuous monitoring were performed in order to establish the effective training load density through the quotient between the time of effective stimulation and the total time of the session, both of them calculated through the heart-rate curve. The differences between periods were determined by using the T paired test. The differences within the group for different moments were determined by ANOVA.

The changes observed in this study in hormonal parameters during specific oriented training periods, suggest the importance of cumulative training effect on the pituitary gonadal axis. The variation of those parameters is reversible within the training process and shows a relation between volume and density of the workload.

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#### P11T-13

### The application of sonophoresis with mucopolysaccharidase and Diclofenac gel in patients after the non-operative treatment of the rupture of Achilles tendon

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*Keywords: rehabilitation, Achilles tendon rupture, sonophoresis*

The rupture of Achilles tendon is one of the most common sporting injuries. Recently, it is more and more being treated non-operatively. After the long period of immobilization, an adequate program of medical rehabilitation is necessary.

In the period between 2000 and 2002, we treated forty outpatients with the rupture of Achilles tendon after the recreational sporting activity. Immobilization lasted eight weeks, during which the contractures of various degrees of the ankle developed. Patients were divided into two equal groups. The range of movements in the ankle, presence of pain and volume of the joint were evaluated in each group. Patients in both groups underwent kinesitherapy, hydrotherapy and occupational therapy. In Group I, sonophoresis with Diclofenac (0.8 W/cm) was applied, while in Group II sonophoresis (0,8 W/cm) was applied with Thyomucase gel (mucopolisaccharidasae).

The results were summarized after two weeks. In Group I, 60% of patients experienced the reduction of pain, in 25% a decrease of the ankle volume was observed, while 33% had increased amplitude of movements in the ankle. In Group II, 40% experienced the reduction of pain, in 75% the ankle volume was decreased and 80% had a significant increase of movements in the ankle.

We conclude that the application of sonophoresis with mucopolysaccharidasae is useful in many ways as an introducing procedure to kinesitherapy of patients after the non-operative treatment of Achilles tendon rupture.

## Poster Session

## Health and Fitness 5

P11U

## P11U-01

**Software to store and analyse anthropometric data**

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*Keywords: anthropometric data, data base*

At present, anthropometry plays a vital role regarding different areas such as: health, sports, industry and other areas of information technologies. However, there is an enormous lack of informatic tools as far as this area is concerned. Therefore, the main goal in development of this program is to help those who work within these professional areas. This program includes a database to store anthropometric data and an application for anthropometric analysis.

We opted to subdivide the program into two blocks: the former consisting on a traditional database; the latter on a calculation program and visualisation of the data stored in the former block. The software used to create the storage support for all the information was Microsoft Access. The database is organized into eighteen related tables where are stored data corresponding to the following types: biosocial, daily life routines, anthropometric data, scholar achievement and maturation. The visualization module is an interface of query and analysis of the stored information in the database. This module was conceived to support research projects and it is provided with the following features: Automate and analyse database data; store information about norms of anthropometric data of previous research projects; creation of norms based in data stored in database; self-capacity of a creation of a smaller database only of anthropometric data; to become a tool of general use freely available in the Internet.

Through the utilization of normalized measures, the module enables the researcher to estimate fat free mass and fat mass, to calculate somatotypes, maturational level (bone maturation and relative height), an assemble of normalized indexes and much more calculations.

The program still permits the researcher: to compare the same individual in different moments; to compare several individuals and to compare one or more individuals with a reference population. This software started to be developed due to the necessity to store and to deal with a vast anthropometric data of the infant population of the city of Lisbon.

As far as the handling of the information is concerned, in a first phase, this application is a rejoinder of the best that has been done and presented by other authors in this area. Our main contribution is to provide a single work tool, as much user-friendly as possible, and make it available in the short term, to the widest group of people.

## P11U-02

**Accuracy of VO<sub>2</sub>max prediction equations of the 2-km walk test in active seniors**

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*Keywords: testing, aging, aerobic capacity*

Direct measurement of maximal oxygen consumption (VO<sub>2</sub>max) requires maximal effort of the subject and substantial laboratory readiness. In large, middle-aged and elderly populations, this direct time consuming method is inappropriate. The 2-km Walk Test is a simple test, which offers VO<sub>2</sub>max prediction equations for working age population.

The purpose of this study was to explore the accuracy of VO<sub>2</sub>max prediction equations of the 2-km Walk Test in active seniors aged 60-76.

Twenty-seven active women and men (67±4 yr) participated in the study. VO<sub>2</sub>peak (l.min<sup>-1</sup>) was measured during cycle ergometry by direct gas analysis from a maximal test (step: 30Watts, time: 2min30). VO<sub>2</sub>peak related to body mass (BM) was then calculated (ml.min<sup>-1</sup>.kg<sup>-1</sup>). Subjects completed also the 2-km Walk Test (UKK INSTITUTE). VO<sub>2</sub>max (l.min<sup>-1</sup>; ml.min<sup>-1</sup>.kg<sup>-1</sup>BM) was then predicted from age, sex, Body Mass Index, heart rate and walking time measured during the 2-km Walk Test. Relationships between predicted VO<sub>2</sub>max and measured VO<sub>2</sub>peak values were observed calculating correlation coefficients. Measured values were compared with 2-km Walk Test prediction equations via mean difference analyses, and bias was explored using Bland-Altman analyses.

Predicted VO<sub>2</sub>max and measured VO<sub>2</sub>peak were highly correlated ( $r > 0.72$ ,  $p < 0.001$ ). Predicted VO<sub>2</sub>max (1.33±0.5 l.min<sup>-1</sup>; 22±6.8 ml.min<sup>-1</sup>.kg<sup>-1</sup>BM) was not significantly different from measured VO<sub>2</sub>peak (1.37±0.49 l.min<sup>-1</sup>; 20.19±4.8 ml.min<sup>-1</sup>.kg<sup>-1</sup>BM). By using Bland-Altman plots, predicted VO<sub>2</sub>max showed no significant bias.

The 2-km Walk Test offers an accurate VO<sub>2</sub>max prediction in an active senior population though a pretty important bias could be observed in few subjects. This test can be used to evaluate VO<sub>2</sub>max in a population presenting these characteristics.

Supported by the FFEPGV (French Federation of Physical Education and Voluntary Gymnastics), the Auvergne DRJS (Regional Direction of Youth and Sports), the AFRAPS (French Association for Research in Physical and Sportive Activity).

## P11U-03

**Figuration in change**

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*Keywords: physical education, figuration, gender perspective*

Physical Education (from the beginning called "Gymnastics") has been a subject in the Swedish schools for almost 200 years. What has happened with the syllabuses over the years and the figuration of the subject? Since 1842 the subject has

changed name five times: from Gymnastics to Gymnastics with play and sports and then back to Gymnastics. After that the name changed to Sports and finally, in 1994, it was named Sport and Health. The aim of this study is to get an overview of the research made of the PE subject in Sweden during the last forty years to get hold of the changes of the subject's figuration.

This study is based on a describing literature study of research made on the PE subject, during the time period 1962 to 2002. The results are viewed in light of a gender theoretical perspective.

In early 1960s the subject was based on a health- and hygienic discourse, and gymnastics was an important part of the subject. Gymnastics was in that time separated for boys and girls into two different discourses, from the ages of 12 and up. In 1970 the physiological discourse affected the subject and gave it a partly new orientation towards conditioning training and activities. Three lessons (40 minutes) per week were recommended. In 1980 coeducation was recommended for all ages in the compulsory school and a unisex body movement culture started to develop, which was suitable for the two sexes. In the 1980s the figuration of the PE subject turned strongly towards the sports discourse where ballgames became the most frequent activity. In 1994 the new curricula developed from centralistic steering towards decentralization with a goal-orientated syllabus. For the compulsory school the time allotment was reduced to approximately two lessons (50 minutes) per week. For the upper secondary school the time reduction was approximately 50%. A new health discourse was put forward in the syllabuses, where questions about lifestyle and physical activity got in focus - and still are (2002). The figuration of the content has slowly started to change.

The subject has turned from a physiological discourse including gymnastics and sports activities to a focus on health and social interaction (pedagogical discourse). The rationalities behind the new orientation of the subject need to be studied further.

#### P11U-04

### Predicting maximal heart rate from the UKK 2km walk test results: soft computing and linear regressions methods

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*Keywords: maximal heart rate, soft computing, prediction*

Exercise prescription is a practical tool to enhance individual's health and physical activity. The standard principles for the prescription are mode, frequency, intensity and duration of the exercise. The intensity prescriptions are mainly based on the % -levels of the maximal heart rate (HRmax). HRmax can be measured during maximal exercise test. These tests are, however, expensive and not feasible in population studies. The simplest method to predict HRmax is to use the age-dependent equations e.g. 220-age. For individuals, the accuracy of those equations are less than desirable for safe exercise intensity prescriptions. The aim of this study was to introduce and test two methods to predict HRmax.

These methods were a previously known Multiple Regression analysis (MLR) and a new Total Fuzzy Similarity -method (SIM). The study material (156 men (M) and 99 women (W)) was collected from the research databases of the TRCSM. The included subjects were healthy adults, age: 20-60-yrs, and they had underwent the directly assessed

maximal treadmill test and the sub-maximal UKK 2km Walk Test. The data was divided in to two parts (M:80+55, W:55+44). One part was used for training (building the model and optimising the weights) and the other part was used for testing.

For the SIM- and the MLR -models the mean differences ( $\pm$ SD) between the measured and the predicted HRmax were 0.0 ( $\pm$ 8.8) and 0.4 ( $\pm$ 8.3) bpm for the M. The total prediction errors were 8.7 and 8.3 bpm, respectively. The prediction models explained 36% and 42% of the variation in the measured HRmax. The corresponding values for the W were 0.6 ( $\pm$ 8.3) bpm, 2.2 ( $\pm$ 7.5) bpm and 8.2 bpm, 7.7 bpm and 17%, 33%. The linear AGE-models explained 18% and 7% of the variation in the measured HRmax in the M and W. The total errors were 9.9 bpm and 8.7 bpm, respectively.

We have introduced two new methods to predict HRmax from the exercise test results. Both models seem to give a bit better predictions than the traditional age dependent linear models. The new methods may enhance safety of exercise by increasing the accuracy of individual intensity prescriptions.

#### P11U-05

### Physical activity and health-related fitness of older adult females in Sakhalin (Russia)

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*Keywords: physical activity, health-related fitness*

For the residents in snowy regions, physical activity during snowfall is one of determinants of the health promotion. In Russia, some people are engaging in physical exercise because of home farming in their cottage named "Dahcha". Although the aim of the physical activities in a "Dahcha" is to compensate lower family income, these activities seemed to be an effective supplement for physical inactivity with the results that exercise intensities during working in a "Dahcha" correspond to 30-59%HRreserve. The purpose of this study is to examine the relationship between physical activity and health-related fitness of older female adults in Yuzhno-Sakhalinsk (Russia).

Subjects were 48 elderly females who did not have any serious medical treatments, living in the city of Yuzhno-Sakhalinsk. Among them, 24 are engaging in home farming in Dahcha during weekend time, and 24 older adult females did not engage in Dahcha work. After giving informed consent, all subjects were asked to perform a Physical Fitness Test, developed by the Japanese Ministry of Education, Sport and Culture, including grip strength, sit-up, trunk flexion, one leg standing with eyes opened, 10m hurdle walk and 6 minutes walk, and to respond to questionnaires on self-reported health status and activities of daily living.

More than half of both groups are classified as overweight or obese. There were significant differences between the two groups for grip strength, sit up, one leg standing with eyes open and 10m hurdle walk. Physical fitness score of the Dahcha group were significantly higher than of control group. In this study we investigated the effects on physical activity of Dahcha work. Our results suggest that home farming relate with improvement of physical fitness for older females, and that physical activity of Dahcha is effective in Sakhalin.

## P11U-06

**Measurements of forearm activity with accelerometers in dependent elderly****Matsui Takeshi**

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*Keywords: physical activity, accelerometer, dependent elderly*

Assessment of the physical activity of dependent elderly staying in a nursing home with accelerometer seems helpful in designing the home's activities. However, many dependent elderly have physical handicaps such as hemiplegia. Therefore, they walk very slowly and their steps do not make sufficient impact to accelerometer attached to their waists. Therefore, in this study, I attempted to measure forearm activity with an accelerometer to assess the physical activity of dependent elderly.

Four men and seven women (aged  $83 \pm 8$  years) staying in a geriatric health services facility participated in this study as subjects. The total count and level of forearm activity were measured using an accelerometer. The device was attached to subject's healthier arm to collect the 24-hours data on one weekday and a weekend. To assess the physiological intensity, heart rate (HR) was measured by memory device on the same weekday.

Forearm activity levels divided into 11 levels (0, 0.5, 1-9) of intensity were obtained every 2 min. More than 99 % of total frequencies were observed in lower four intensities (0, 0.5, 1 and 2). The mean resting HR and the mean HR reserve ( $220 - \text{age} = \text{resting HR}$ ) were  $65.2 \pm 7.3$  bpm and  $72.2 \pm 11.9$  bpm respectively ( $n = 7$ ). On the basis of this HR reserve, frequencies of HR were calculated every 10 % intensity. About 95 % of frequencies that are higher than 0 % of HR reserve were observed in lower four intensity levels (0-10 %, 11-20 %, 21-30 %, 31-40 % of HR reserve). There was a significant correlation between forearm activity level and corresponding HR in each subject ( $p < 0.05$ ).

Forearm activity level relates the corresponding HR level. So, to assess forearm activity level seems to be useful for estimating the physical activity level of dependent elderly. Total count of forearm activity on weekday that has some recreational activities didn't differ from that on weekend that has no extra activities. This indicates that there is still room for improvement in planning of daily activities which increases physical activity level. It was suggested that the estimation of physical activity using forearm activity level with accelerometer is helpful in developing such an activity program in nursing homes.

## P11U-07

**Effects of supine floating on heart rate, blood pressure and cardiac autonomic nervous system modulation in females****Masahiro Nishimura, Onodera Sho**

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*Keywords: blood pressure, supine floating, cardiac vagal modulation*

The purpose of the present study was to clarify the effects of supine floating (SF) on heart rate, blood pressure and cardiac autonomic nervous system modulation during the early follicular phase in female.

Ten women served as subjects ( $n = 10$ , mean age 20.9yrs.). All subjects gave informed consent before participation. We used a cot and test tank placed poolside. All subjects wore a swimming suit during the experiment. Water and room

temperature were 30 and 27 degree Celsius, respectively. All subjects rested on a cot for 15 minutes. Then, these subjects performed supine floating, for the same period of quiet rest (control) for 15 minutes. It have been reported that autonomic nervous system changed and/or did not during menstrual cycle. Thus experiments were performed the same time of different day during the period of 4th to 9th day of menophania. All subjects were instructed to breathe gently in time with metronome signal set at 15 breaths/min (0.25Hz). Electrocardiogram (ECG, CM5) was recorded during final 5 minutes of rest (BASE: baseline period) followed by supine floating for 15 minutes. Heart rate was derived by calculate the number of R wave of ECG. Blood pressure was measured at the end of the BASE, at 5, 10 and 15 minutes of supine floating. Analysis of heart rate variability (HRV) was performed off-line on a personal computer. Cardiac autonomic nervous system modulation was estimated with the power spectrum analysis of heart rate variability (HRV) by using the Fast Fourier Transformation (FFT). The areas of the two frequency components of HRV were measured by integrating low frequency (LF; 0.04- 0.15 Hz) and high frequency (HF; 0.15-0.40Hz). HF was used as an indicator of cardiac vagal modulation and was showed logarithmically (LogHF).

Heart rate during supine floating was lower than BASE value; however, there was no significant difference. Systolic blood pressure during supine floating decreased significantly as compared with the BASE value. LogHF during supine floating at 5 minutes increased significantly as compared with the BASE value. Heart rate, blood pressure and LogHF during control did not change.

These data indicate that cardiac vagal modulation during supine floating is enhanced. In female subjects, changes in cardiac vagal modulation induced by water temperature and hydrostatic pressure during supine floating (horizontal immersion).

## P11U-08

**The fitness of students enrolled for physical education degrees****Wilhelm Marta, Demeter Andrea, Hajduné László Zita, Rétsági Erzsébet, Herlicska Károly**

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*Keywords: physical education, fitness, lifestyle*

The fitness of future physical education teachers depends on both their former sports carrier and also the requirements set by the university curricula.

At the beginning of the schoolyear 2001/2002 we started a double-blind follow up study to investigate the body composition and physiological changes caused by the different track and field requirements. In the first year 79 (mean age:18,73 years) students, in the second year 73 new students (19,29 years) entered our program. After answering a questionnaire about their lifestyle it was confirmed that more than 60% self-reported themselves as elite sportsmen. Indeed their somatotype and fat mass indicated that most of them were ecto-mesomorphic, or meso-ectomorphic. The fat mass averaged between 9,92-12,07% for men, and 18,73-19,35% for women.

In the second year of our study we found in those women who were repeatedly examined that the average body mass did not change, fat mass decreased, while for men both parameters were increasing slightly. In both sexes muscle mass subsided too. This finding is supported by the decrease in the mesomorphic character. Although vital capacity does not determine VO<sub>2</sub>max, it is an important factor of aerobic

performance. The studied population's vital capacity was 84.5-95.03% of the expected FVC. In agreement with these findings the 1,500 m run average time (5,24 min) was just under the expected minimum level (5,4 min). We calculated Physical Fitness Index with the help of Polar Heart Monitors, and these indeces were just above average. The expected VO<sub>2</sub>max was calculated with a step test. The different groups average was found between 50,58-58,95 ml/kg/min for men, and 35,55-38,41 ml/kg/min for women. This was found to be very low compared to the expected VO<sub>2</sub>max of average 16 year old girls expected maximum (40 ml/kg/min). These findings indicate a need to rethink the effectiveness of the regular physical education system in primary and in secondary schools. It is also important to modify PE students track and field and other basic sports curricula. Without proper athletic bases it is impossible to develop a new and healthy generation.

#### P11U-09

### Health-related physical fitness of young rural and urban girls in relation to the criterion-referenced (AAPHERD)

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**Keywords:** *health-related physical fitness, rural girls, urban girls*

This study aim was to analyze the health-related physical fitness of rural and urban girls in relation to the criterion-referenced for desirable HRPF established by AAPHERD (1988).

Sample was composed of 252 rural and 447 urban girls (10.5 to 17.49 yrs old) who lived in four counties from two states in the South of Brazil (Rio Grande do Sul and Santa Catarina) where most of the population is descendant from Italian, German and Polish. The rural area is characterized by small pieces of land (less than 51 hectares), with very few or inexistent mechanization, due to unfavorable land topography. HRPF were measured according to AAPHERD (1988): cardiorespiratory fitness (1600 m); muscular strenght/endurance (1-min sit-ups); flexibility (seat and reach); body fat (triceps, TR + calf, CL).

The percentage of rural and urban girls who met the criterion-referenced standars, were the following, respectively: 1600 m (97% and 56%); sit-up (27% and 9%); seat and reach (81% and 74%); and, TR+CL (51% and 39%).

Considering all HRPF components, results have shown an alarming situation, once half only 14% of all rural girls 3% of all urban girls met the criterion-referenced. However, there is more scientific evidence that cardiorespiratory fitness is inversely related to the incidence of degenerative diseases than all remaining HRPF. Thus, it can be hypothesized that only a small portion of the rural girls (3%) may be affected by any degenerative disease now and in later life, while more than half (44%) of the urban girls would have an elevated risk to develop health problems. The differences in cardiorespiratory fitness level could be related to the differences in lifestyle between urban and rural population. AAPHERD (1988). Physical best.

*Crespo CJ et al (1998). MSSE, Suppl, 30: 80.*

#### P11U-10

### Body composition and somatotype in female team handball players

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**Keywords:** *body composition, handball, anthropometry*

Athletic performance is affected by body structure, energy capacity and neuromuscular skills. Kinantropometric studies have shown that high performance requires specific morphological characteristics. The aim of this investigation was to record possible differences in anthropometric characteristics of Greek female handball players in three different competitive levels.

Three groups of female handball players participated in this study. One group of 101 players of A1 League [age 23.2 (5.3) yrs], another of 75 players of A2 League [age 19.8 (3.9) yrs] and 46 players of B Category [age 17.6 (4.1) yrs]. Body height (BH) and body mass (BM) were measured, whereas body mass index (BMI) was calculated for all subjects. Percent body fat (BF) was estimated from the measurement of four skinfold thicknesses using the equation of Siri (1956) for three different ages. Somatotype was determined according to Heath & Carter method (1967). All anthropometric parameters were taken according to the guidelines of Heyward & Stolarczyk (1996). The differences among groups were compared using one-way analysis of variance (ANOVA). Statistical significance was accepted at  $p < 0.05$  level.

Significant differences were found on BH and FFM in League A1 compared to the League A2 and Category B, while the difference in BF was significant among all the three groups of players. With regards to ENDO, significant difference was found between the two competitive level (League A1 and A2) and B category ( $p = .000$ ), while the difference in MESO was among all three groups of players. The main finding in this study was that A1 League players somatotype is mesoendomorphic, while A2 League and B Category were endomesomorphic. The somatotype of other European female handball players reported by other authors is mesomorph-endomorph (Eiben, 1981), or endomesomorphic (Stepnicka, 1979). It is worth noting that the mean percent body fat observed in all the three age groups studied was higher than the value of ~20%, which is reported in the literature as characteristic of the female team ball games players (Gualdi-Russo et al., 1992).

#### P11U-11

### Effects of a 1-week sojourn at moderate altitude (2000 m) on the sleep quality in the elderly

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**Keywords:** *moderate altitude, quality of sleep, hiking*

World-wide there are approximately 100 million high-altitude visitors annually and about 15 % of those are elderly (Burtscher 1999). Sleep disturbances are common in elderly persons and may even be exaggerated at high altitude (Montgomery 2002, West 2001). However, little information exist on the sleep quality at moderate altitudes (Zielinski 2000). Therefore, sleep quality was studied in elderly subjects during a 1-week stay at 2000m.

The study group comprised 20 voluntary healthy elderly subjects (males and females) without any acute or chronic illness. During the 1-week sojourn both groups were accommodated in comparable hotels at low (600 m) and at moderately high altitudes (2000m). The daily hiking duration was increased from 2.5 to 5 hours during the one-week period. Resting pre- and post-hiking cardiopulmonary variables were measured daily. Sleep quality was recorded by daily standardized interviews.

The one-week hiking program was well tolerated by all subjects both at low- and high-altitude. Post-hiking heart rates were increased on all days at moderate altitude compared to low altitude ( $p < 0.05$ ), however, after overnight rest heart rates did not differ between groups. A similar tendency was observed concerning heart rate variability. Sleep quality was higher in the moderate-altitude group compared to the low-altitude group throughout the study ( $1.48 \pm 0.34$  scores versus  $0.90 \pm 0.40$  scores,  $p < 0.05$ ).

In conclusion sleep quality in elderly persons is better at moderate altitude compared to low altitude and may well contribute to a fast recovery after prolonged hiking. This observation is also supported by the marked recovery of resting heart rates and heart rate variability after overnight rest at moderate altitude. Therefore, much of the enhanced stress during exercise at low ambient oxygen pressure compared to low-altitude conditions may be balanced by the increase in sleep quality at moderate altitude.

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## P11U-12

### Relationships between bone mineral densities, energy expenditure and body composition parameters in young physically active and inactive females

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**Keywords:** *physical activity, energy expenditure, bone mineral density*

The purpose of this investigation was to compare bone mineral density (BMD, measured at wrist, pelvis and spine sites of the skeleton) of endurance trained females to females whose physical activity was considered active loading (weight training) and to a physically inactive females, and to investigate whether BMD is related to energy expenditure (EE) and body composition parameters in young females.

Subjects were physically inactive ( $n=12$ ;  $26.0 \pm 4.4$  yrs;  $167.0 \pm 3.1$  cm;  $59.7 \pm 7.5$  kg, BMI:  $21.4 \pm 2.8$  kg/m<sup>2</sup>; fat percent:  $22.1 \pm 2.8$  %), endurance trained ( $n=27$ ;  $24.9 \pm 5.2$  yrs;  $167.6 \pm 5.0$  cm;  $57.7 \pm 4.9$  kg, BMI:  $20.5 \pm 1.3$  kg/m<sup>2</sup>; fat percent:  $20.6 \pm 1.3$  %), and strength trained ( $n=10$ ;  $25.5 \pm 8.1$  yrs,  $166.7 \pm 4.6$  cm,  $64.8 \pm 8.0$  kg, BMI:  $24.4 \pm 4.7$  kg/m<sup>2</sup>; fat percent:  $23.8 \pm 2.9$  %) young females. All studied females were eumenorrheic (10-12 cycles/year). Body composition and BMD were measured with dual-energy X-ray absorptiometry (Lunar Corporation, Madison, USA). EE was assessed using a questionnaire.

Body mass, lean body mass, fat mass, fat percent and BMI values were not different between inactive and endurance

trained females but were significantly lower ( $p < 0.05$ ) compared to strength trained athletes. No differences in wrist BMD were found between studied groups (inactive females:  $0.9 \pm 0.1$  g/cm<sup>2</sup>; endurance trained females:  $1.0 \pm 0.2$  g/cm<sup>2</sup>; strength trained females:  $1.0 \pm 0.1$  g/cm<sup>2</sup>). Endurance ( $1.3 \pm 0.2$  g/cm<sup>2</sup>) and strength ( $1.4 \pm 0.1$  g/cm<sup>2</sup>) trained females presented significantly higher values for pelvis BMD in comparison with inactive females ( $1.0 \pm 0.2$  g/cm<sup>2</sup>). Spine BMD was significantly higher in physically active females (endurance trained females:  $1.3 \pm 0.2$  g/cm<sup>2</sup>; strength trained females:  $1.4 \pm 0.1$  g/cm<sup>2</sup>) compared to physically inactive females ( $1.1 \pm 0.1$  g/cm<sup>2</sup>). Correlation analysis indicated that mean energy expenditure was significantly related to BMDs measured at spine ( $r=0.50$ ;  $p < 0.05$ ) and pelvis ( $r=0.40$ ;  $p < 0.05$ ) but not wrist ( $r=0.26$ ;  $p > 0.05$ ) sites of the skeleton. In addition, all assessed body composition parameters were also related only to spine ( $r > 0.44$ ;  $p < 0.05$ ) and pelvis ( $r > 0.46$ ;  $p < 0.05$ ) BMD values. No relationships were observed between measured body composition parameters and BMD value measured at wrist. In conclusion, the results of the present study demonstrate that BMDs measured at spine and pelvis sites of the skeleton in young females depend on the total amount of physical activity performed.

## P11U-13

### Lifestyle family determinants associated with childhood obesity

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**Keywords:** *obesity, lifestyle, overweight*

The number of obese children doubled since 1980 in USA, in Europe the situation is the same. Therefore, obesity is nowadays considered an epidemic disease in the developed countries. The causes are nurture and nature; however, whether or not childhood obesity can truly be inherited still remains a mystery, because it is difficult to separate the variables of lifestyle and gene's within a family in order to study causes of obesity, since adult's habits (diet, physical activity level, etc.) tend to affect their children in the same way. So, the purpose of the study was to verify the association between lifestyle family variables (socio-economic status, family's involvement on a physical activity programme and family member's ship association into a club) with overweighted and obesity in 6-10 years age children.

The sample included 451 males and 409 females 6-10 years age. The family data were available by a questionnaire applied to the children and filled by their parents and teachers. Overweighed and obesity was calculated by the body mass index assessment and the cut of points of Cole et al. (2000). Association was assessed using the Phi, Cramer and contingency table correlation tests.

Positive and significant associations were found among lower family socio-economics status and childhood overweighted and obesity, non-physical activity parent's practice (mother and father) and childhood overweighted and obesity, non-involvement from parents in an association club and childhood overweighted and obesity.

The results indicate that parent's lifestyles are associated with childhood obesity, showing the important role that parents must have in the solution of that epidemic disease.

Cole, T. et al. (2000). *Establishing a standard definition for child overweight and obesity worldwide: international survey*. *BMJ*, 320: 1-6.



## P11U-14

**A survey of body fat percentage (%BF) in athletes and comparison with international standards****Ghanbari Mojgan**

Sport Medicine Board of Tehran, Iran

*Keywords: body fat mass*

One of the main goals for the athletes in many fields of sports is increasing the lean body mass and decreasing the fat mass. The body needs a specified amount of fat mass for the natural functions, however the extra fat mass has a destructive effect on the body is performance. In this research, the amount of the fat mass of the athletes participating in the medical university matches was measured and then the measured fat mass was compared to the international standards.

This research was done on 330 sportsmen and 270 sportswomen who participated in the 5th medical university matches. The main focus on this research was on the sex of athletes. Thus a sample of 30 athletes was selected in each group. At first the weight and height of these athletes was measured. Then the body fat mass was measured by the bioelectric impedance method.

- Body fat mass of male athletes in Wrestling, Basketball, Swimming, Shooting & Volleyball was higher than international standards. - Body fat mass of male athletes in Taekwon-do, Track & Field, and Chess, Soccer was in the range of international standards. - Body fat mass of male athletes in Tennis, and Badminton was lower than international standards. - Body fat mass of female athletes in shooting, Tennis, Track and Field Fitness was higher than international standard. - Body fat mass of female athletes in Chess, Volleyball, Swimming, and Badminton was in the range of international standards. - Body fat mass of female athletes in Basketball was lower than international standards.

## P11U-15

**Relationship between physical activity, aerobic fitness and blood lipid profile in 9- to 11- year old children****Krekoukia Maria, Nassis George, Psarra Glykeria, Zerva Anastasia, Skenderi Katerina, Sidossis Labros**

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*Keywords: aerobic fitness, blood lipids, physical activity*

The aim of the present study was to examine the relationship between physical activity (PA), aerobic fitness (AF) and lipid profile in prepubertal children.

Fifty-four children (28 boys and 26 girls) aged  $10.0 \pm 0.7$  years (mean  $\pm$  SD) took part in the present study. BMI was used for the classification of children in obese ( $N=26$ ) and lean ( $N=28$ ). Physical activity was assessed with a triaxial accelerometer (RT-3, Stayhealthy, Inc., CA). Aerobic fitness was evaluated with the submaximal physical work capacity at 170 beats/min (PWC170) test. Additionally,  $VO_{2max}$  was predicted using appropriate equations. Venous blood samples were collected after a 12 hours fast. Analysis included the determination of serum total cholesterol (TC), triglycerides (TGs), high-density lipoprotein cholesterol (HDL-C), low-density lipoprotein cholesterol (LDL-C), apolipoprotein A (Apo A) and apolipoprotein B concentration. A 2 X 2 ANOVA (group X gender) and Pearson correlation coefficient were used for the statistical analysis. Obese children presented higher TGs and lower HDL-C and Apo A concentration compared to lean ones (TGs:  $76.6 \pm 34.2$  vs  $50.4 \pm 18.6$  mg/dL; HDL-C:  $45.1 \pm 8.6$  vs  $51.8 \pm 9.0$  mg/dL; Apo A:  $117.2 \pm 24.6$  vs  $130 \pm 16.3$  mg/dL, respectively,  $p < 0.05$ ). Boys presented lower TGs and higher HDL-C concentration compared to girls (TGs:  $53.8 \pm 28.5$  vs  $73.9 \pm 28.9$  mg/dL; HDL-C:  $50.5 \pm 10.0$  vs  $46.3 \pm 8.2$  mg/dL, respectively,  $p < 0.05$ ). For all subjects, hard PA correlated with lower TGs concentration. A negative relationship also appeared between vigorous PA and TGs concentration ( $r = -0.274$ ,  $p < 0.05$ ). In girls, very light and light intensity PA was positively associated with HDL-C concentration. Additionally, a positive relationship ( $p < 0.05$ ) was presented between very light intensity PA and Apo A, whereas a negative correlation ( $p < 0.05$ ) was presented between very light intensity PA and TGs concentration in females. In boys, no significant correlations were found between various components of PA and blood lipids. PWC170 was positively correlated with HDL-C and Apo A ( $p < 0.05$ ) whereas predicted  $VO_{2max}$  was negatively associated with TGs concentration ( $r = -0.355$ ,  $p < 0.05$ ) for all subjects. In conclusion, significant relationships were presented among various aspects of PA, AF and blood lipid profile. Some of these relationships were different in boys and girls.

## Poster Session

## Motor Learning 2 – Sociology 1

P11V

P11V-01

**Prepared responses triggered by startle are modified by feedback****Carlsen Anthony, Chua Romeo, Nagelkerke Paul, Franks Ian**

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*Keywords: startle response, movement perturbation, movement preprogramming*

A movement blocking paradigm has been previously employed to examine movement preparation and execution. For example, when movements were blocked, characteristic triphasic EMG responses were observed although no physical movement was possible (e.g. Wadman et al., 1979). However, it was noted that feedback mechanisms contaminated the EMG profile of a blocked response ~50 ms after the block occurred (Nagelkerke et al., 2000). A startle paradigm has been used to overcome this problem. Recent experiments (Valls-Solé et al., 1999; Carlsen et al., 2003) have shown that an acoustic startling stimulus (124 dB), given in conjunction with the "go" signal in a reaction time (RT) task, results in significantly shorter RTs. It was suggested that the startle acted as an early trigger for the prepared response by circumventing normal cortical triggering processes. Thus, it was hypothesized that a response speeded by a startle should retain similar EMG characteristics to non-startled responses in both blocked and unblocked conditions.

Eight participants performed a simple RT task requiring an arm extension to three targets located at 20, 40 and 60 deg. On certain trials the movement was blocked (BL), the participant was startled (ST), or the participant was startled and blocked simultaneously (ST-BL).

As previously reported, during BL trials the EMG pattern was modified ~50 ms following the block (100 ms after EMG onset). In the 60 deg blocked movements, the antagonist burst did not occur, or was largely attenuated. Feedback from the block was available to terminate the antagonist burst before it's onset in the 60 deg movement. The inclusion of a startling stimulus resulted in significantly shorter RTs in both blocked and unblocked conditions. However, there were no differences detected in EMG patterns between ST trials and Control trials for any of the movement distances. Furthermore, there were no EMG pattern differences between ST-BL and BL trials for any of the distances. These results indicate that movements initiated early by a startle are susceptible to feedback processes with a similar time course to normally triggered responses.

Acknowledgements: NSERC

Carlsen AN et al (2003). *J Neurophysiol* 89.Nagelkerke P et al (2000). *J Sport Exercise Psy* 22S:S83.Valls-Solé J et al (1999). *J Physiol* 516.3:931-938.Wadman WJ et al (1979). *J Hum Movement Stud* 5:3-17.

P11V-02

**Sport structures in the European Union****Dancs Szegner Henriette**

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*Keywords: EU enlargement, sport structures, multilateral cooperation*

There are still very many different sport structures/models throughout Europe - probably as many as there are countries. It is clear that the European Commission will not influence directly the sport of each country, but have minimal expectations which could be valid for all members. Critical appraisals can form the basis of defining a more comprehensive and functional model of sport in relation to European membership, and also, it is posited, that it will serve to create a generic representation of a national model throughout Europe. This model could be formed and defined by applying a comparative analysis of the previous European model of sport, and evaluating different national structures. The differences will manifest themselves in the developmental roles of the state, the financing of sport, the judgement of the value and the function of sport among others in every single country.

The main objective of the study is a comprehensive analysis of two different sport structures/ models, one of the UK and the other of Hungary. Differences were analysed, discussed and appraised to establish the following: how much do these structures in Hungary and the UK symbolise the structures throughout the rest of Europe and what can we learn from them in an attempt to move towards defining sport structures/models that might apply in the European Union.

The comparison of the sports structures in the UK and Hungary pose many questions and problems in moving towards a generic model for Europe. The study's goal was to analyse the aims of the European Commission, connecting sport all around Europe after the enlargement of the Union, might be realised. Which are the possible ways of changing sports structures in Europe, particularly with respect to the changes in attitude which are vital to have a pragmatically functioning, multilateral cooperation of different sports organisations, necessary to form a strong - maybe common - European Sport Area? Could sport perform its social role, particularly in its role in the education of young people and in the struggle of equal rights and opportunity, moreover promoting and developing public health as well?

The phenomenon of modern sport could become more important in the ways of tackling different social problems (for example drug problems, protection of the environment, unemployment, etc).

EU official web sit: <http://europa.eu.int/>

## P11V-03

**Performance under high intensity localised muscle fatigue and total body fatigue**

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*Keywords: fatigue, skills, performance*

Research findings on the impact of fatigue on performance to date, remain inconclusive. This is possibly due to a number of methodological problems including the demand of the motor task, the nature of the task performed to induce fatigue and the method used to quantify fatigue. The main aim of this study was to investigate the effects of localised muscle fatigue and total body fatigue on the performance of motor skills.

Nineteen college students (age: 21.68 + 3.77yrs) volunteered to participate in this study. They performed two novel skills, a fine motor skill (pegboard) and a gross motor skill (throwing on target) under three different conditions: rest, localised fatigue and total body fatigue. The tasks were executed after a progressive workload to induce fatigue in which subjects exercised on an arm ergometer or treadmill until reaching the desired fatigue level as determined by percentage heart rate reserve (90% HRR).

ANOVA with repeated measures revealed a significant ( $F_{2, 36} = 4.73$ ,  $p = 0.015$ ) difference between performances under the three exercise conditions on the throwing task and a significant ( $F_{2, 36} = 7.44$ ,  $p = 0.004$ ) difference on the pegboard task.

These results indicate that while localised fatigue seemed to have impaired performance of the gross motor task significantly, total body fatigue seemed to have a less detrimental effect on the same task. The results also suggest that performance of the fine motor skill has significantly deteriorated as a result of both localised fatigue and total body fatigue. The present findings support previous studies such as Devienne (2000) and are in agreement with the theory of detrimental effects of fatigue on performance (Smiliot, 1998). It appears from the present study that both localised muscular fatigue and total body fatigue of high intensity have a detrimental impact on the performance of motor skills. However, the nature of the task being performed seems to determine the extent of adverse impact of fatigue. This deterioration in performance could be due to a shift in the subject's attention from the task in hand to her/his perception of discomfort.

*Al-Nakeeb et al (2002). ECSS 7th Annual Congress, Athens, Greece, 381*

*Devienne et al (2000). Perceptual and Motor Skills, 90, 315-318*

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*Smiliot (1998). Journal of Strength and Conditioning Research, 12(3), 204-208*

## P11V-04

**Degrees of freedom of the arm position in healthy and hemiparetic subjects**

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*Keywords: arm movement, hemiparesis*

In healthy subjects, the eyes rotate with three degrees of freedom about 3 axes: horizontal, vertical and torsional. In the real action, Donders found, that there exists only one eye

position for every gaze direction and that eye orientation restricts the 3D space into 2D space. For the three rotational degrees of freedom of the shoulder, such a reduction was observed in a pointing task (Straumann et al. 1991). We investigated the degrees of freedom (DOF) of all joints of the arm position.

We compared 10 normal and 5 patients with slight arm paresis due to cerebral infarcts in a repetitive pointing task with open and closed eyes. Subjects were instructed to point always to the same location in space. We analysed the standard deviation of the final hand position (STD\_HP) and estimated the dependence of the 7 joint angles on the horizontal and vertical final hand position by means of a multiple quadratic regression. A principle component analysis of the residual error was used to compute the DOF, defined as the number of principle components that covered 90% of the residual error.

The average DOF in normal was 2.6. The standard deviation of the final hand position was 15 mm. Controls were compared with patients when pointing with the affected arm. An ANOVA with the within-subjects factor Vision (with/without) and the between-subjects factor Group (controls/patients) was used. On the DOF both main effects and the interaction were significant showing a smaller DOF in patients (2.1) than in the control group (2.6). The DOF was smaller with (2.4) than without (2.6) vision. The difference between the groups was more pronounced with vision (controls: 2.7; patients: 1.7) than without (controls: 2.6; patients: 2.5). The STD\_HP was smaller with (13 mm) than without vision (18 mm). This effect was stronger in the patients (with: 12; without: 22 mm) than in the controls (with: 14; without: 17 mm).

These results suggest that the patients use vision to restrict the DOF of the arm in order to reduce the variability of their final hand position.

## P11V-05

**Effects of amplified knowledge of results on acquisition and retention in a positioning task**

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*Keywords: motor control, amplified knowledge of results, knowledge of results*

Recent research showed that amplified knowledge of results (KR) could enhance learning in a linear positioning task (Mendes & Godinho, 2000). The purpose of the present study was to replicate the experiment and to deepen the understanding of the effects provided by the amplified KR on motor learning.

Forty (20 females and 20 males) students aged 19-23 years participated in the study. The task consisted of a linear 50 cm movement of the right arm with a cursor (Linear Movement Device: Lafayette Instrument - Model 31202). Subjects performed a total of 125 trials (50 acquisition trials and 75 retention trials). The retention tests consisted of 25 trials each and took place 5 minutes (R1), 1 day (R2) and 1 week (R3) after the acquisition phase. Subjects were randomly assigned to one of four experimental groups: the amplified (AKR) group received amplified verbal KR that indicated that the response was doubling than it was actually the case, the constant amplified + 5 cm KR group (A5KR) received amplified KR that indicated that response was 5 cm too long or too short than it actually was, the correct KR (KR) and the no-KR (NKR). Constant Error (CE) data were analysed using separate analyses of variances (ANOVA's) for acquisition (4 feedback conditions x 2 blocks) and retention (4 feedback

conditions x 3 blocks) with repeated measures on the last factor.

In acquisition the differences between the groups were significant,  $F(3,36)=8.28$ ,  $p<0.01$ . The AKR group maintains the lowest CE in the last two retention tests (Figure 1). These results suggest a positive trend of this form of KR in relation to the other KR conditions. As for acquisition, the main effect for feedback condition was significant in retention. This effect might have been caused by the degraded results of the No-KR group in retention sessions.

As demonstrated originally by Mendes and Godinho (2000) the provision of amplified verbal KR had an influence on the responses in a linear positioning task. The same trend was observed by Mendes, Godinho, Buekers and Chiviawsky (1999) using a coincident-anticipation task. The effects observed with the manipulation of amplified KR were similar, generalised to different motor tasks.

Mendes, R. & Godinho, M. (2000). *Effects of amplified knowledge of results on learning a linear positioning task. Proceedings of V Annual Congress of the European College of Sport Sciences* (p. 491).

Mendes, R. et al (1999). *Effects of amplified KR on learning an anticipation timing task. Actes du VIII Congrès International des Chercheurs en Activités Physiques et Sportives* (pp. 211-212).

#### P11V-06

### Futsal goalkeeper: A test for the evaluation of speed of movements

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*Keywords: futsal, motor skill*

Futsal goalkeeper, given to the short distance and the power of the blows that it endures, must move in short times. The insufficient bibliography concerning this topic has rendered this study extremely interesting. Some authors have defined the speed of movement as a complex quality with the ability to act and to react quickly. The reactivity in the approach to the ball, leaving and arresting themselves belong not only, but also comprising and resolving with succeeding one determined situation of game (Benedek/Palfai '80). Moreover, the external pressures (anxiety, adversaries) add to such characteristics and strongly affect the action speed. To estimate the movement speed, holding in consideration the numerous members who act, is not an easy task. In a pilot study Benvenuti (2000) has validated a test (Test-VS) in a position to measure such an ability on athletes of elite Soccer 5 and handball players. This research has the scope to verify the reliability of such test adapting it to the role of the porter.

The study has been carried out on nine athletes of elite (series To) Soccer 5 players (age  $24,11 \pm 5,80$ , kg  $73,35 \pm 5$ , cm  $174 \pm 3$ ) in addition to the rigor air 5 eliminating marks, 5 cones, a semicircular area and one telephone exchange electrical worker were used. The telephone exchange electrical worker was used in order to activate the ignition of two sequences of movements (seq. 1: B, D, To, C, And, B; seq. 2: D, and, To, C, B, B) predefined but not known by the athletes. The five luminous marks were disposed along the line of the rigor air to indicate the movement direction. The subject must leave from the center of the door as soon as it sees the first mark eliminated and catch up as fast as possible to a place 4 meters from the departure point. The second mark will be only ignited when the subject, returning in the departure point, enters in the marked semicircle on the

ground of the beam with 1 meter diameter from that point. The recovery of the subject between a sequence and the other are total.

The test has been repeated, as indicated in literature within a single day; in order to avoid that greater intervals of time could condition the data of the study. The collected data have been analyzed by means of correlation Test/Retest.

The relative coefficient values of correlation between Test and Retest in two sequences ( $r = 0,89$  for the seq. 1 and  $r = 0,88$  for the seq. 2) have evidenced an optimal reliability (Tab.1). The constructed machinery can be used beyond that for obvious scopes of appraisal, like means in order to train the speed of movement, the ability to advance and reaction and the rhythmic variation of steps in change of direction. With the use of various sequences, always new, the porter can train the own attentive abilities and the speed of complex reactions.

Donati A (1997). *Scuola Informa*, No 39, 31-45

Benvenuti C (2001). *Nuova Atletica*, No 169-170, 12-18

Benedek E, Palfai J (1980) *Fussball-600 Uebungen*

#### P11V-07

### Choice reaction times modified by interlimb coordination

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*Keywords: reaction time, bilateral deficit, interlimb coordination*

When simultaneous bilateral movements are produced in reaction time (RT) tasks, RTs are longer than in unilateral conditions. This phenomenon is known as "bilateral deficit". Ohtsuki considered that there may be at least three possible mechanisms subserving these bilateral deficits: division of attention, reciprocal inhibition, and interhemispheric inhibition. If the division to different body parts was the main cause of the bilateral deficit, then not only the simultaneous use of symmetrical muscles should cause the deficit, but also the simultaneous use of muscles anatomically distant from each other. At the last congress, I reported the case of simple reaction time task. The purpose of this study was to determine whether bilateral deficit is exhibited by nonhomologous muscles in the case of choice reaction time task.

Subject performed ten choice RT push-button tasks; with the right hand (RH), left hand (LH), right foot (RF), left foot (LF), RH and RF, RH and LF, LH and RF, LH and LF, RH and LH, and RF and LF. The order of the tasks was randomized. Subject performed twenty trials by ten blocks. Each blocks consisted of twenty trials.

A three-factor analysis of variance, with two limbs (hand and foot) x two sides (right and left) x four conditions (single, with the contralateral same limb, with ipsilateral different limbs, and with contralateral different limbs) revealed that RTs for hands were lengthened when combined with feet compared to a single situation and RTs for feet were also lengthened when combined with hands compared to a single condition. These results suggest that division of attention may be one of the causes of bilateral deficit in choice RTs.

Ohtsuki (1994). *In Interlimb coordination: neural, dynamical, and cognitive constraints*, Academic Press, 259-274

Swinnen et al (1995). *Exp Brain Res* 104: 153-162

Taniguchi et al (2001). *Exp Brain Res* 137: 259-268

P11V-08

**The effects of overlearning on a procedural motor skill****Dunphy Ross, Smyth Patrick, O'Keeffe Siobhán**

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*Keywords: overlearning, procedural skill, disassembling, assembling*

One way of enhancing retention of motor skills is the use of overlearning i.e. additional practice on a task after it has been learned to a required criterion. Procedural skills seem to be particularly susceptible to forget and would be appropriate for testing the effects of overlearning. Schendel & Hagman (1982) had soldiers of the USA army learn how to disassemble and assemble a machine gun to a criterion of one perfect trial and found two overlearning groups to be superior to a non overlearning group on an 8-week retention test. There was however no difference between the immediate overlearning group (IO) which engaged in 100% additional practice on reaching the criterion, and a refresher group (RO) which did 100% additional practice after 4 weeks. It was recommended on the basis of cost and effectiveness that the IO procedure should be adopted. There is a need to test the generalisability of that finding to other guns and other populations of soldiers. The purpose of this study was to test the effects of overlearning on disassembling and assembling a Browning Automatic Pistol (BAP) by soldiers of the Irish Defence Forces.

Thirty male soldiers, mean age of 26 yrs and with no previous experience with the gun, were randomly selected from a battalion. They were required to practice assembling and disassembling the pistol until the criterion of one perfect trial was achieved. The soldiers were assigned to an IO group, an RO group as above except that this group undertook overlearning after 3 weeks, and the control group C which undertook no further practice. After 6 weeks all three groups were tested for retention.

The IO group was superior to the control in number of errors at trial 1, overall errors, and number of trials at retention. The RO group did not show differences when compared to the C or IO groups however, RO to C comparisons are approaching significance.

Results of IO group are consistent with Schendel & Hagman (1982) while the results for the RO group are not. IO practice is best for retention of disassembly and assembly of the BAP.

*Schendel J, Hagman J (1982). J App Psych 67: 605-610*

P11V-09

**Comparison of simple reaction time in case of simple and difficult but skilled movement****Varga Mátyás, Vass Zoltán**

Semmelweis University, Budapest, Hungary

*Keywords: judo, reaction time*

The purpose of this case study is to recognize whether the difficult skilled movement has longer simple reaction time than a simple movement or not. Our hypothesis is that the difficult skilled action can not have longer simple reaction time (SRT) because these actions are only one chunk, and are automated, and the response programming stage of the information processing needs just minimal attention. In Klapp's (1995) article it is mentioned that practice makes from two or more chunks one. Without practicing, the movement contains more chunks and after the stimulus the

process SEQ has to scan the first chunk to initiate the movement.

The subject was a first class male judo player, a student of the Semmelweis University, Faculty of Physical Education and Sport Sciences. The analyzed movements were: one skilled judo technic and finger tipping. The judoka had to execute the movements 6 times, each to a light stimulus. These were recorded by video cameras, to have reaction time by frame counting method.

The results show that there is no significant difference between the simple reaction time of the two types (difficult but skilled and simple) of movement. It shows that the information process in case of the difficult movement does not need more attention than in case of the simple movement, and this movement is only one chunk, so scanning the first is not needed. Further plans are to analyze the kinematical reproducibility of a skilled movement with statistical probes.

*Klapp ST, Erwin (1995). Journal of Experimental Psychology: Human Perception and Performance, 21, 1015-1027*

P11V-10

**Sports participation and violence - a German-Israeli comparison****Hofmann Jürgen**

University of Paderborn, Germany

*Keywords: physical activity, violence, intercultural research*

In a cross-cultural comparison between Germany and Israel a sample of about 3.700 German and 2.700 Israeli adolescents (age: 11-16 years) were confronted with a questionnaire in 2001-2002.

This questionnaire contains several aspects of sports participation, self-concept and different forms of violence and aggressive behaviour.

These different aspects were set into relation via multiple regression analyses for the whole sample. The influence of socio-demographic predictors, social and body-oriented facets to self-efficacy and general self-concept and furthermore to the dimensions of violence (physical violence, psychological violence and delinquency) is analyzed.

The results indicate, that parent relations and different sexes are the most determining factors, although boys and girls do not differ in the field of physical violence in Israel. The main result is, that involvement in sport has no direct influence on physical violence, psychological violence or delinquency. Also indirect influences via self efficacy or self-esteem are negligible. Therefore the moderating effects of sports participation to violent behaviour have to be neglected.

Research is still in progress and regression analyses will be repeated with the subsamples of German and Israeli boys and girls to see possible relationships and differences. Perhaps different forms of sport such as individual vs. collective sport or with vs. without body-contact can identify relationships between sports participation and violence. Results will be presented at the congress.

## P11V-11

**Inter-limb coordination in trained older women**

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*Keywords: elderly, inter-limb coordination, rhythmic gymnastics*

The aim of the present study was to verify differences of inter-limb coordination in 15 sedentary and 15 rhythmic gymnastics trained older women (61-70 yrs). Subjects performed flexion and extension of hand and foot in the sagittal plane with a 1:1 frequency. Two homolateral conditions (preferred and non-preferred limbs) were tested with in-phase and anti-phase coordination modes. Each condition was performed at three velocities (80, 120, and 180 beat.min<sup>-1</sup>) for 60 s maximum.

No significant difference was found among body side preference. Main effects were found for group [ $F(1, 28) = 267.15, p < 0.0001$ ], with trained women showing always significantly better values, and for the interaction group x coordination mode [ $F(1, 28) = 40.04, p < 0.0001$ ], group x velocity of execution [ $F(2, 56) = 10.23, p < 0.0002$ ], and group x coordination mode x velocity of execution [ $F(2, 56) = 28.32, p < 0.0001$ ]. Sedentary subjects always showed significantly lower values ( $p < 0.01$ ), especially with increasing velocity and in the anti-phase condition. Trained women did not show any negative velocity effect in the in-phase condition and decrements were significantly lower ( $p < 0.01$ ) only in the anti-phase mode.

All subjects performed better at lower velocities of execution and during isodirectional tasks (Baldiessa et al, 1991; Serrien et al, 2000). The trained group showed significant velocity-related coordination decrements during anti-phase movements, which rely on increased monitoring and attentional resources to overcome the more elementary in-phase mode. While age-related deterioration in synchronization capabilities of sedentary older subjects indicates that central and/or peripheral factors weakened with aging, the trained group showed percentages of success higher than those reported for young adults (18-28 years) in both the in-phase and the anti-phase coordination modalities (Capranica & Olivieri, 1999).

The present results suggest that a rhythmic gymnastics training program, implying various movements under strict temporal constraints, tremendously improves inter-limb coordination in older subjects while a sedentary lifestyle is mainly responsible of the observed age-related decrements.

Capranica L & Olivieri B (1999). *Italian J Sport Sci* 7: 32-36.  
Serrien DJ et al (2000). *J Gerontol: Psych Sc* 55B, 3: P295-P303.

## P11V-12

**Communal sports infrastructure as a factor of promoting public health**

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University of Leipzig, Germany

*Keywords: public health, communal sports infrastructure, sport participation*

Physical activity promotes individual health by enhancing physical and psychological well-being, improving social integration and reducing the risk of many diseases. In 1976, Germany and Greece among other member states of the

Council of Europe joined the European Charta "Sports for all". The European Charta appeals to the member states to initiate inclusion policies in order to make public physical activities accessible to all social groups. The main receivers of these political recommendations are the actors of the sport system. They should encourage inclusion of all social groups. According to Luhmann's inclusion thesis "all functional contexts shall become accessible to all participants of social life".

The aim of this study was to investigate the sports infrastructure in Cologne and Thessaloniki and its effect on sports participation rates in both populations. This study postulates that a successful communal sports policy has to provide a sufficient number of sports facilities in order to stimulate sports activity of the citizens. In this respect, it was examined if the two cities follow consequent inclusion policies for middle-aged individuals.

Both populations, the Greek and the German, are convinced of the positive effects of physical activity participation. However, a main difference consists in the fact that the Greek state doesn't provide an adequate number of sports facilities. This is one of the reasons which lead to the low sports participation rates in the Greek population which are ascertained in this study. The results of the Greek population deviate by far from the results of other European countries as found in similar studies.

## P11V-13

**Motivations and expectations towards physical activity in elderly and relations to psychophysical health state (SF-36)**

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Interuniversity Centre for Bioengineering and Sports Sciences, Italy

*Keywords: motivation, physical activity, SF-36*

Aging of population and increase of life expectations, especially for women, point out the need of a planning for policies to prevent states of non self-sufficiency. Although benefits of physical activity are well-known, a low proportion of older people has active lifestyles. Knowing attitudes toward physical activity of active people may be a useful step to set interventions for promoting physical activity. The study examines motivations/expectations towards physical activity, in a group of active aged women, and their relations to health state.

Data for 456 women aged >55 y., attending courses of physical activity in 2001-02, were examined. The study analyzed the relations between sets of motivations and expectations and the SF-36 scales: Physical Functioning (PF); Role-Physical (RP); Bodily Pain (BP); General Health (GH); Vitality (VT); Social Functioning (SF); Role-Emotional (RE); Mental health (MH) and the two summary measures, Physical Component Summary (PCS) and Mental Component Summary (MCS).

"Health benefit" is the motivation that collects higher consents (81.2%), followed by "spending time with friends" (20.8%) and "medical advice" (19.6%). Other motivations collect less than 10.0% of preferences. Between expectations, "improvement in physical condition" shows the higher consent (52.0%), followed by "feeling better" (43.1%), "improvement in health" (26.0%) and "enjoying free time" (17.2%). Data show significant relations between motivations/expectations and the SF-36 scales. Many motivations appear related to distress in psychophysical health state. E.g., people selecting "medical advice" as motivation show lower scores in PF ( $p < 0.05$ ), RP ( $p < 0.05$ ), BP

( $p < .001$ ), PCS ( $p < .005$ ), indicating higher suffering in these physical dimensions. Instead, relational motivations appear related to lower scores on mental scales: e.g., "spending time with friends" is chosen by subjects with low score in RE ( $p < .05$ ), MCS ( $p < .05$ ).

Knowing the attitudes towards physical activity is a step to set programs to promote active lifestyle. Data suggest that participating in physical activity is not necessarily related to a well-being condition; in spite of this, for some people states of distress may be transformed in stimulus to an active lifestyle. Besides, the fact that only 26% of subjects believe in improvement in health by practice physical activity, indicate the need of carrying out communication strategies to reinforce the beliefs about the advantages of active lifestyle.

#### P11V-14

### Doping awareness among adolescents

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*Keywords: doping, adolescents, educational interventions*

Doping represents a widespread problem in athletes of all levels and ages. The anti-doping policies go from the improvement of drug testing technologies and modalities, to educational interventions in order to reduce the intent of adolescents in using doping substances. After some doping scandals, several prevention programs were claimed by media and national institutions.

The aim of this study was to verify the effectiveness of these claimed educational interventions investigating the consciousness among adolescents of the potential health risk of doping practices and evaluating their inclination in using drugs to enhance performance.

1600 students between 16 and 18 years old were involved in the study. They were asked to fill a standardized and anonymous questionnaire: 1) Do you think the use of drugs could have potential risk for health?, 2) Do you approve high level athletes which use doping to enhance their performance?, 3) Could you assume drugs to win important competitions like Olympic Games?, 4) Has anyone ever asked you to assume some doping substances?. Results were analysed using Pearson's X<sup>2</sup> test. Adolescents involved in sports were 74.3 % of which 50.5% at competitive level. 6.1% of student thought that doping does not have potential health risk and 10.7 % ignored doping effect on health. 7.6% approved the use of drugs among high level athletes and 5 % admitted that someone has proposed to use doping substances. Students that could assume drugs to win important competitions were 16.2 % while 26.5 % were uncertain.

Despite the claimed anti-doping policies, the results of this study showed an elevated number of student favourably disposed towards doping utilization. Moreover, adolescents ignoring health risk of doping showed a lack of information about side effects of performance-enhancing drugs. As specific educational interventions were demonstrated to decrease the intention to use doping (Laure and Lecerf, 1999) among adolescents, these results seem to indicate insufficient prevention programmes. As we have also shown that 26.5 % answered "I don't know" to the question about a possible use of drugs to win important competitions, we think that urgent more effective interventions by government are needed urgently in order to educate adolescents to be able to refuse future doping practices and to educate young people about health risk of drugs use.

Laure P, Lecerf T (1999). *Arch Pediatr*, 6:849-854

#### P11V-15

### Barriers to womens participation in sport and recreation from the perspective of less priviledged countries

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*Keywords: barriers to sport, less privileged countries*

The barriers to women participating in sport at all levels are well documented. Social constraints remain strong barriers to women's involvement in sport and, particularly in performance sport (82% have never been actively involved in Competitive Sport). The validity of high level sports performance by women needs to be continually stated and their engagement and dedication supported, especially in less privilege countries.

Concerning the research study aim a questioner for evaluation of the Social Attitudes, Psychological and Physical Barriers to women's participation in sport and recreation has been applied on the sample of over 150 girls and women, subdivided in 5 age categories. Research results were processed with non-parametric statistics procedure.

There are strong views as to which sporting activities are considered suitable or unsuitable for girls and women. Many women lead multi complex lives with the result that they frequently feel too tired to consider participation in sport and physical activity. (Reasons for: to keep physical abilities 44%, aesthetic 23%, health 16%, a rest of the duties 11%, social 5%, others 1%).

Governing bodies and coaches should take account of women's commitments when considering the training patterns and competitive requirement of their sport. Women can find the lack of transport a principle barrier to their participation in sport at all levels. (Means of transportation: on foot 75%, on bicycle 4%, public transport 9 %, own car 12 %). Women choose following recreate activities as most interesting: Aerobics 21%, Swimming 18%, Bicycle riding 11%, Walking 8%, Fitness 7%, %, Tennis 5%, Horse riding 4%, Volleyball 5%, Basketball 4%. For women who work, the support of employers is essential, but the lack of recognition of women's sports sometimes means this support is not forthcoming and work demands can prevent women realizing their full potential.

#### P11V-16

### Sportive personality under the pressure of social problems

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University of Craiova, Romania

*Keywords: social pressure, experience, personality*

Being aware of the sphere o social pressure is necessary to action against their consequences. This aspect has remarkable consequences for sportive performance and not giving the rightful support during critical situations may interrupt sportive activity of a person. Most of the time the coach consider very important only the content of the training. The answer given by the sportsmen during the training has its roots in his social activity. The lack of concentration starts from a line of events. Their cause must be known in order to eliminate the effect. This paperwork offers a line of data of which the leaders of the sportive training process should know in order to obtain victory during competitions.

P11V-17

### The social relevance of the public policies for sport and leisure for the city of Curitiba, Parana State, Brazil.

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Catholic University of Curitiba, Brazil

*Keywords: leisure-time, public policies*

The physical activity, sport and leisure programmes developed by public policies promote a better quality of life and the social inclusion of the citizen. According to Svoboda & Patrickson (2000), the dominant value for sport activities is its social effect and that the public policies have an enormous responsibility while guaranteeing the sport for all citizens of the city as often as possible. The objective of this study was to verify the social relevance of the public policies for sport and leisure developed by the city of Curitiba, Parana State-Brazil.

The sample was composed by 260 subjects enrolled in the actives developed at Cajuru Sport and Leisure Center, which is ruled by the City of Curitiba. The age group of the subjects ranged from 10 to 50 years old, male and female. The facilities of this center include a gymnasium and an open court.

Primarily, it was asked to the subjects if they have been attending any other sport facilities for their regular activities. For this question, 76% answered that the Cajuru Sport and

Leisure Center was the only one which gave them an opportunity to practice during the all year. 58% of the subjects answered that they kept participating with assiduity during summertime, even without a swimming pool. When asked about why the subjects used to come to the Cajuru Sport and Leisure Center, it was possible to verify that 27% just practiced some sport and/or physical activity while the remain 73% use it to meet friends, to stay away from daily routine and also practice some sport and/or physical activity. The social relevance of the public policies was more evident when it was detected that 23% of the participants had no relatives taking part of the activities. 38% had brothers and/or sisters, 19% had uncles and/or aunts and cousins, 8% had their fathers and 12% had their mothers participating together. Related to the frequency to the Cajuru Sport and Leisure Center, it was verified that 51% of the subjects did their activities twice a week, 28% three times a week and 21% four times or more each week.

The results showed that the public space for physical activity, sport and leisure could be transformed in a meeting center which provided social inclusion for both men and women of many age groups. According to the 'Chart of Athens' (Le Corbusier, 1989), the proper use of the free time is a content of the urban treat and this is also one of the basic priorities for the wellness of the citizen and the city itself.

*Le Corbusier (1989). A carta de Atenas. Svoboda B, Patrickson G (2001). Il ruolo dello sport nella società.*

## Poster Session

### Physical Education and Pedagogics 1 – Sociology 2 – Philosophy 1

P11W

P11W-01

### The aesthetic categories: a way to enhance sport aesthetics understanding

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*Keywords: aesthetics*

Contemporary sport has arrived at such a high level, and the physical capacities have been pushed to such biological high limits that it is urgent to find new dimensions to represent and interpret excellence and success in sport. Sport aesthetics emerges as a possible reply to the need of rethinking the meaning of sport in the future. The boundaries to Sport Aesthetics rely on human imagination, which means that it is, in a certain way, inexhaustible.

Mapping the anatomy of aesthetic experience through sport is of central importance for the exploration of aesthetic problems. An old but renewed and arguing domain is the identification of aesthetic categories, the ways of beautiful. Most studies proceed from claims and statements of scholar and there is few work grounded on empirical data.

The main goal of this study was to compare the opinion of sport sciences professors and Visual Arts university professors (n=138), about aesthetic categories.

An intensity scale (from 1 to 5) was used to find out the importance each group ascribes to several categories of aesthetic value in sport.

Expressiveness and perfection were the most important categories to sport sciences professors, while creativity and balance became the first ones to Visual Arts group.

The identification of these categories in sport aesthetics helps to clarify the subject and shows its importance as some

sort of strength, able to provoke certain effects in audience that allows asserting they have been through an aesthetic experience.

*Cordner C (1995). Differences between sport and art. In William J. Morgan & Klaus V. Meier (eds.), Philosophic inquiry in sport, (second edition), pp. 425-436. Champaign, Illinois: Human Kinetics Publishers, Inc.*

*Hyland D (1990). Philosophy of sport.*

*Kuntz P (1985). Aesthetics applies to sports as well as to the arts. In David L Vanderwerken & Spencer K Wertz (eds.) Sport inside out, 492-509.*

*Lacerda, T. (2002). Elementos para a construção de uma Estética do Desporto. Dissertação de doutoramento.*

*Osterhoudt, R. (1991). The philosophy of sport: an overview.*

*Witt G (1989). The world of sport - A world of aesthetic values. Sport Science Review, 10-15.*

P11W-02

### Experts in gymnastics: How to get there?

**Nunomura Myrian**

University of São Paulo, Brazil

*Keywords: coaching, gymnastics, professional preparation*

Nowadays in Brazil we have seen very little Gymnastics or nothing at all in the Physical Education classes from the early children up to youth. Why it could happen if our Physical Education was originated from the European Gymnastics models and it represented the main content in the curricula for years? What changed the concept of Physical Education in our schools? The media? The society's demands? The human beings needs?



Maybe all these facts have, in certain level, influence on the content of Physical Education we have nowadays. But we also think that the professional preparation is one of the reasons. In some Universities the Physical Education curriculum doesn't include the discipline of Gymnastics. The emphasis in our courses is on team sports and games. And what about the content of Gymnastics such as Artistic Gymnastics, Rhythmic Gymnastics, General Gymnastics, Aerobics, and other forms? This scenario puts on the market professionals who are not well prepared to deal with Gymnastics. Consequently, some of them don't approach any kind of Gymnastics or as it should be. Specialization courses, after the undergraduation, have been one of the alternatives for those who look for subsidies that could bridge the gap. Understanding that it could be one of the possibilities to enhance professionals knowledge and improve their skills, we have designed and ran a course in Gymnastics.

The subjects were 36 professionals who have been working in schools, sport clubs, and other institutions. Some have just started to teach and others have been working for years. We inquired them about the importance of Coaching Education. Some of the answers were: (1) it could be an alternative to improve as a coach, no matter if orientating beginners or elite athletes; (2) as it has been achieved good results in other countries, why not in Brazil; (3) it will be positive if we have good course conductors; (4) it would promote the sport; (5) it will be good if it could be close to our reality; (6) it is necessary since the content in the undergraduation course is poor.

According to the answers, we may conclude that the subjects are positive about an implementation of a Coaching Education, and they emphasized that it should not be a mere copy from other countries, but we have to have our own program specifically directed to our professionals. Another important conclusion is that the perspective of career growth for a coach though, demands much more than an undergraduate program can offer.

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#### P11W-03

### The deontology of the profession of sports between coercion and freedom

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*Keywords: professional deontology, sporting jobs, responsibility*

The activities of physical education and sports are practiced, guided, financed, advised, studied, controlled and assisted medically etc. by a great number of workers - generally called sporting workers. The crowd of active participants - those with the main role sustains the activities of physical education and sports, first of all. In Romania the active participants are co-opted in specific activities of the aspect of organizing physical education and sports: physical education and sports in schools and universities, physical education in military units, professional physical education, mass sports, sport of performance.

In Romania, immediately after 1990, the premises of the development of professional sports were created. Sports

exceed the strict domain, which devoted it. Sport is considered a notable social phenomenon - an affirmation that imposes the equilibrium between normative and the pre-programmed behavior of man, those that must be controlled in order to become social. One must be nature and culture at the same time - human nature is dependent on its socio-cultural status.

The paper proposes to point out the necessity of informing sporting workers and the active participants to the activities of physical education and sports about the rigors of deontology of the didactic profession. The social norms which respect configures the professional deontology, are imposing a line between freedom and respect of the juridical norm. In the state of law, in an authentical democracy, freedom demands control, anticipation, importance, co-ordinates self-control and adjustment - understood and represented like this it could be confounded with the juridical conscience - the form of social conscience. Where there is no social conscience, the necessity of juridical responsibility is placed in front in all those situations in which it could be engaged.

The treatment of the problem which is concerned by the principles of juridical responsibility is imposed by the keen necessity of the juridical adjusting of the activities of the physical education and sports, and at the same time to bring them - as a possible object of labour and professional job into the attention of the jurists and on the other hand to make all the active and passive participants to the phenomenon of sport to realize the keen necessity of a harmonious framing of this phenomenon in the context and the rigors of a civilized behavior of the highest morality, but of a strict legality and responsibility.

#### P11W-04

### Sport initiation for children in São Paulo sport clubs

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*Keywords: sport initiation, sport clubs*

There seems to be a consensus that children obtain many benefits on participating in sport and physical activities. However, questions like "how" and "when" these kind of practices should start still remain in parents and professionals' mind. In Brazil, children sport initiation usually occurs in schools and some private sport clubs. How does it happen? What are the objectives and characteristics of these programs? When do children start a specific sport? The purpose of the present study was an attempt to answer and clarify some of these questions.

We interviewed coordinators of five sport clubs in Sao Paulo City, whose clubs have been offering sport initiation programs for children between three and 12 years old. They were inquired about their program, the objectives, contents, qualification of the professionals involved, and their expectations in relation to the participants.

The results showed that four of these programs did not have competition as their main goal and the emphasis was on the development of the whole children, offering a wide range of experiences for all participants, no matter their level of ability or somatotype. In regard to the structure of classes, it was possible to see a division into two groups per age. For three to six years old group, the concern was to offer a variety of activities that could expand motor experiences. In the six to 12 years age group, the participants might select one, two or more sports among artistic gymnastics, soccer, volleyball, basketball, handball, and tennis. The objective of that phase was to put the participants in contact to a variety of sports,

suggesting that one of them would be his/her choice in the future. Those sport programs still keep an exploratory nature, but they are a little more specific if compared to the previous group. The objective of this phase is to put the participants in contact to a variety of sports, suggesting that one of them would be his/her choice in the future.

Moreover, it is possible to say that these institutions have been trying to develop the sport initiation programs concerning to the variety of activities and experiences and promoting the development of the children as a whole. It is also noteworthy to report that four of the programs analysed are grounded on a consistent literature regarding to the motor development (Gallahue & Ozmun, 2001), which suggests a coherent content.

#### P11W-05

### Cultivation of social values through sport in the development - case study: Woodball

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*Keywords: woodball, social values, intrinsic motivation*

There are several basic levels within sport itself: school sport, university sport, recreational sport, sport for disabled persons, amateur sport and professional (elite) sport. Woodball (invented 1990 in Taipei by Mr. Ming-Hui Weng and Mr. Kuang-Chu Young) is one of the youngest sports that have been played at almost all of these levels in a very short period from its appearance, taking into account that it is still in stage of development. The aim of this qualitative research was to investigate which social values are cultivated during different woodball events and to understand intrinsic aspects of the players for participation in this interesting sport.

The effects of the game on players and active participation in recent woodball events (international and local championships and tournaments, courses, conferences, workshops and parallel cultural events) were explored using systematic observation and unstructured interviewing.

We concluded that the following social values are permanently cultivated: enhancing positive and cohesive relationships between players, sensitivity and respect for others, leadership support, co-operative learning, incorporating personal in collective action and creating safe physical and social environment.

In comparison with similar sports, there are some special characteristics of woodball which make it unique and attractive for playing: self-determination of the level of the game, designing own woodball courses, effectiveness of the game and atmosphere of positive social relations during the game. Also, it is evident that woodball significantly influences in the advancement of intercultural relations, especially international cultural co-operation between some European countries and the Far East.

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#### P11W-06

### The coach pedagogical behaviour: comparison between two settings and two practice levels

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*Keywords: soccer, behavioral profile, coach*

In this study we try to describe and compare the soccer coach's behaviour when training a Sport Club Team and when training a Sport School Team. We also try to describe and compare the Soccer Coaches Behaviour when training with two formation stages: under fourteen and under sixteen. The importance of the coach role in the children and youth formation shows the importance of this investigation about their pedagogical activity, among young people.

Our sample was 24 soccer coaches (12 of under fourteen and 12 of under sixteen; 12 of Club Sport and 12 of School Sport), and we registered and analysed 24 trainings - one from each coach. We applied the categorical observation system SOTA - Observation System of the Coach - consisting of 5 dimensions and 16 categories.

We verified the differences and similarities between the coaches' behaviour in Club Sport and in School Sport.

So, we can say that there are no significant differences towards the dimensions and categories of the system. Only the category Attention to Verbal Interventions has registered significant differences, with a higher score in the School Sport Coaches. Comparing only the behaviours of the under fourteen Coaches, there are no significant differences between the two environments, with the exception of the dimension Activity (more used in the School environment). The category Correction also registered significant differences, with a higher rate in the Club context. Comparing only the under sixteen coaches behaviour, we haven't found significant differences and, therefore, between the two general profiles. We found significant differences in one dimension -Instruction - and in two categories - Demonstration and Attention to Verbal Interventions. The differences registered towards these categories and dimension show a higher frequency of such behaviours in the School Sport. We also verified the differences and similarities of behaviour between the under fourteen coaches and the under sixteen coaches. Only the category Correction has registered significant differences, with a higher score for the under fourteen coaches. When we compared only the Club Sport coaches, we concluded that the category Correction also registered significant differences, with a higher frequency among the under fourteen coaches. Finally, comparing only the Sport School coaches, we haven't found significant differences in anyone of the dimensions and categories in analyses.

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#### P11W-07

### Perspectives of curriculum development in physical education in Hungary

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*Keywords: physical education, curriculum,*

The latest challenge for physical education in Hungary is posed by the country's joining the European Union. To mark the European way is not an easy task, because it is impeded by several problems, such as: different ethnic and (body)

cultural traditions, languages, economic situation, differently evaluated training aims, tasks, demands, or different curriculum regulations -, this latter one is the theme of this paper.

With presenting the results of a questionnaire based on answers of Hungarian teachers of physical education, we try to indicate the directions of a euroconform P.E. curriculum development (matching the needs of the European Union). The theme consists of the following: mapping the people involved in curriculum development, terms of curriculum changes, solving the problems of the choice of teaching material.

The questionnaire was based on the answers of practising physical education teachers (n=1164) in primary, secondary and higher education. The sample can be considered representative, as one-seventh of the total population addressed sent the answers back; the representative sample covered all 19 counties of Hungary and Budapest, the capital, as well.

An anonym questionnaire was used for testing. One part of the statements, formulated in the questions, had to be answered with yes or no by the PE teachers. The answers for the other part had to be circled on a 5-degree scale mostly reflecting the opinions of the teachers. Besides recording the basic statistics, the chi-square test was applied to show the differences between the yes or no answers. The answers on the 5-degree scale were compared with the F, t and D tests.

In the short summary of our results the following can be stated: All physical education teachers expressed their opinion that physical education can only match future demands of society if it can offer a variety of movement activities to pupils in school.

#### P11W-08

### Is the "Super Tie-Break" good for tennis: an ethical discussion

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*Keywords: tennis, ethics, philosophy*

There is a tendency to frame sports ethics simply in terms of right and wrong conduct. While this way of viewing sports conduct has a respectable home in modern moral theory, it has had the unfortunate consequence of relegating critical discussion to questions of the good life to a merely subjective status. According to the ancient ethics of the Greeks, however, ethics is part and parcel of good living - it is not a special sphere of rule-formulated principles of right action. In this paper we argue that tennis flourishes when all or most of its goods are practised and perfected by committed practitioners and supported by institutions that are respectful of its particular goods, histories and traditions. We ask, in particular, if tennis will flourish if the "Super-Tie Break" is formally written into the rules of the game or whether it is simply an ingenious innovation or misguided idea fated to diminish or even damage the game.

We approach the problem by reflecting critically on the nature of tennis in terms of a type of complex human activity as outlined in MacIntyre's (1985) celebrated thesis. On this account, the "Super Tie-Break"; is good for tennis if it is a full and fair test of the skills of players since these are the internal goods (eg court craft, skilled execution) of the game. We argue that the "Super Tie-Break" lessens the skill required to play the game and therefore compromises the integrity of the game. Whilst elite tennis could not survive without the support of institutions, their parasitic logic is

corruptive (McNamee, 1995). Essentially, the "Super Tie-Break" seems more likely to reduce the outcome of matches to luck or chance rather than skill and other embodied capacities such as strength and stamina. Tennis institutions such as the International Tennis Federation, and tournament promoters, appear to have embraced a change in the technical rules of the game that prioritise the acquisition of external goods (e.g. status, TV revenues) at the expense of the achievement, promotion, refinement and extension of the internal goods of the game. We conclude with the need to resist this innovation and to promote decision-making and virtues (McNamee, 2002) that are respectful of the internal goods, histories, and traditions of tennis.

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#### P11W-09

### An application of Searle's critique of cognitivism in the development of sport theories

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*Keywords: cognitivism, conceptual analysis*

One of the most popular approaches to conceptualize human performance in sport is the information processing approach. The computer model of the mind is central to this approach. Since the computer is a device that carries out computations, the human has also been thought of as a computing system. This is one of the basic assumptions behind cognitivism. In this paper I will take a closer look at John Searle's critical objections to cognitivism and point at some implications for sport research that is based on the cognitivism-Searle controversy.

First I will consider Searle's Chinese Room Argument (see Searle 1980; 1997). The argument is supposed to show that computation is not sufficient for cognition (Preston 2002). There has got to be something in addition to the computational process that makes us understand, etc. Later, Searle develops the argument in relation to the distinction between features that are intrinsic to a system and features that are observer-relative to a system. Intrinsic features are basic features of a system. Their existence does not depend on an external interpretation. Mass is an example of an intrinsic feature in nature. On the other hand, observer-relative features are dependent on how humans treat them. The piece of paper we call money is an observer-relative feature, because it is only money due to some interpretation. Searle bases his further analysis on the assumption that computation is an observer-relative feature. Thus, syntax cannot be intrinsic to the physics, Searle argues. This is a new argument that is supposed to show that computation cannot be necessary for cognition, either (ibid.). Since Searle thinks that our focus should be on how a system's intrinsic properties work, he uses Ockham's razor to remove the computational level, which lies between the neuronal and the phenomenological level. The computational level for Searle is superfluous.

What might the implications of Searle's arguments be for sport research? Several things have to be discussed. First, are Searle's arguments convincing? Second, what do his arguments imply for an established conceptual apparatus in sport research? Third, does Searle give us any new concepts to work on?

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#### P11W-10

### The physical education and the new Brazilian sportive trends

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*Keywords: culture, trends*

The practice of a physical activity is present in peoples' life during all phases, particularly in school phase. However it's possible to identify differences between the work developed at school and the work developed in gyms or sportive clubs. It's perceived that the schools for Physical Education had been unrespected by our society marked by the image, maybe because of the incomprehension that the sportive has multiplie ways and attitudes. An important point about the building of a good curriculum for the physical education classes can be found through the objectives and contents proposed by the brazilian National Curriculum Parameters (PCN's) focusing it's conception and social importance. To the professional that works in the elaboration of. this document the "nature of the developed work in the Physical Education has a strict relationship with the well known comprehension about the conception of body and movement." The PCN's was made with the objectives guided to the education, based on the universality, equally, social value orientation, ethics and in the formation of the human being. The Physical Education allows to try different body practices arising from different cultural manifestations. Dances, sports, fights, games and gymnastics, composite a varied combination of influences creating a huge cultural patrimony that may be valued, known and usufructed, allowing a critical analysis of the social values, like the standards of beauty and health, that turn to dominant in the society. The cultural diversity that characterizes Brazil has a big fan of learning possibilities; offering to the professor subsidies to enhance the work with creative aspects and with a artistic approach. When a child attends school it brings a series of knowledge about movement, body and body culture from it's own experiences, owns to the school the task to work with the local cultural inventory, starting by the lived experiences, but guaranteed the access of experiences that they couldn't reach out of the school. It's believed that to focus on the physical education works through a huge and centered vivency in the new social values will be the way guarantee the practice of some physical activity during the life.

#### P11W-11

### Some characteristics of female elite sport careers

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*Keywords: gender difference, sport career, social characteristics*

The aim of the study was to analyze how Slovene society perceives athletes from the viewpoint of gender differences. Society perception will be represented through the analysis of athletes' conditions for training and competition,

characteristics of education during a sport career, and the socio-economic status (passive and active). The study focuses on society pointers, which significantly influences social status and conditions for training and competition of elite athletes.

The sample included 210 Slovene elite athletes (107 male, 103 female), aged between 13 and 43 years (M=22 yrs). The athlete's social position in Slovene society was assessed with AS-01 questionnaire (Doupona Topic & Cecic Erpic, 2001). The questionnaire measures socio-demographical characteristics, characteristics of the athlete's education, conditions for training, competition and characteristics of athletic life-style during the active sport career. A chi-square and one-way ANOVA between subjects were conducted to assess gender differences.

Results of ANOVA showed that type of sport influences the bettering of athletes' material status (highest differences are in individual sport disciplines, especially in skiing and cycling). Analysis of gender differences showed that female athletes earn less financial rewards, have more difficulties getting scholarships, and have less positive stimulations for successful sport career development from social environment than their equally successful male co-competitors.

The results of the study showed that there are gender related differences in social opportunities, which manifest in quantity of social (financial) support. Particular sport disciplines have special status in the society, which significantly influence an athlete's mobility in the class structure.

#### P11W-12

### Sport information and research for physical education in Ukraine

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*Keywords: physical education, information centre, library*

There is a problem of a lack of sport information resources and modern information technologies in Ukrainian physical education and sport science during the last years. The paper aims to define the main needs, purposes, methods and guidelines of information processes in the sphere of physical education and sports in present time Ukraine. The problem of examining information flow in the fields of Sports, Physical Culture, Recreation and Leisure is at the limelight in the modern Sport and Information Sciences.

Sport science literature analysis, Internet search, statistics were used.

The information system of Sport Science includes five information centres in Ukraine. They are based on the universities with a sport profile and are incorporated with the traditional libraries there. The main centres are at the National University of Physical Education and Sports in Kiev, at Lviv, Dnipropetrovsk, and Donetsk State Institutes, and at the Kharkiv Sport Academy. There are several main areas of literature in these centres: Theory of Physical Culture and Sports, Biomechanics, Physiology, Biochemistry, Psychology, Pedagogic, Rehabilitation, Recreation, the History of Sports. The authors present the results of analytical and practical research of the current situation in these institutions and provide essential possibilities for improvement in the sphere of sport information.

Modern needs to information support in the field of physical education and sport sciences in Ukraine are:

\* Development of an integrated information environment in sport education and science, based on the information network of academic institutions; to define one of the

institutions of physical culture and sports as a central block of the network;

\* Establishment of modern information technologies with the goal of a high quality and free access to a wide range of sport information; net-based library service at physical education institutions and other sport organisations; development of sport data bases, specialised hardware and software applications, flexible schemes for study and research needs;

\* Integration of new information technologies with 'real life' sport practice, elaboration of special knowledge based materials for the most popular sports as well as tutorials and manuals for coaches and sportsmen based on computer technologies; development of institutional, regional and national web-sites oriented to the sphere of physical education and sports.

#### P11W-13

### Coaching handball in different youth grades. Analysing the youth handball coach decisions, expectations, behaviour and self-perception

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*Keywords: coaching, behavior, self-perception*

This study intended to contribute to the knowledge in sport pedagogy during the coaching process. This study aimed to describe and compare the youth handball coaches' planning decisions, expectations, behaviour and self-perception, in three groups of teams during the training sessions in the national competition season at sport clubs.

We videotape and interviewed fifteen coaches during their activity in the handball training sessions at their clubs. We have got data from two sessions in the national competition season for each coach. They were coaching male teams and grouped on three level grades: Level 1 - "Iniciados" - 12 and 13 years old; Level 2 - "Juvenis" - 14 and 15 years old; Level 3 - "Juniors" - 16 and 17 years old. We used an interview half-structured before the training session to access the coach planning decisions and expectations. We also used another interview after the training session to access to the coaches' behaviour self-perception. The interviews were analysed by using a content analysis method. We proceeded the interview codification through the information units. We applied the Coach and Athlete Observation System (CAOS) to identify the coaching behaviour (instruction; management; interaction; control and activity). We used the Fisher's Exact Test and the Kruskal Wallis Test to compare the results of the variables studied in the coach groups, submitted to a  $p \geq 0.05$ .

Related to the coach decisions, data only showed significant differences in one category concerned to the theory or practice ( $F=13.876$ ;  $p=0.000$ ). About the pedagogical behaviours we only find significant differences at the category Non-Motor Activity ( $K=8.983$ ;  $p=0.011$ ). Concerning the self-perception we only find one significant difference ( $F=14.959$ ;  $p=0.002$ ) in the category "athletes' diagnostic".

This data led to the conclusion that the pedagogical coaches decisions, behaviour and self-perception were not different among the three groups of coaches.

This research pointed to the coaching process, planning decisions, expectations, interactive behaviour and self-perception, and indicated only few significant differences between the groups that could give us the feeling that coaches were quite stable in youth handball coaching process. The authors suggest more research about the

relations between the cognitive and behaviour variables, concerning the coaching process.

#### P11W-14

### Physical activity and sport in public high-school pupils' representations

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*Keywords: age difference, social representation, gender difference*

Despite many voices that declare sport as a form of leisure without any important educational outcome, sport practice is a real part of moral and ethical leanings, in the socialization process and every-day interaction (Coakley, 2001). The purpose of this paper is to evaluate the social representations and opinions concerning the sport phenomenon.

The research is an opinion poll based on an questionnaire, applied on a 15-17 years old scholar population, their parents and teachers, combined with a number of interviews and discourse analysis. The base for the selected population is represented by the official databases of the structure of Bucharest public scholar network and the number of children in each school.

As option, the practice of sports is gender and age differentiated; while the girls consider their level of physical activity as being equal (40%) or lower (31.2%) than children of the same age. On the other hand, boys declared their level of physical activity equal (36.7%) or higher (32.8%). Sport options are: football (59.5%), swimming (51.7%) and basketball (47.8%), for boys. Girls express their first option for swimming (59.3%), followed by tennis (46.2%) and volleyball (41.2%). On the other side, adults declared a higher level of sport activity in the fellowship of their children/pupils, but the latest did not agree on this.

The analyses reveal that all subjects have a low level of information, practice and active involvement in the sport area. In all investigated populations the representations of sport and physical activity are commonly mixed up. Both of them are associated with health, leisure and fun. Even if the importance of physical activity practices in maintaining a healthy life is generally accepted this is mostly a common sense attitude and does not suppose in depth reflection to this topic. The social, educational and cultural aspect is not present (or is present in a small proportion) in the definition and associations given by the subjects. This reflects a poor information and a low status of sport as an educational discipline or as a social practice which may generate positive outcomes, life-styles and environmental ways of leisure. The appetite for sport action is more likely a passive one, comparable to the non-involvement tendency described in social activism model of Putnam (1993).

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## P11W-15

**The effect of the offside law at the breakdown to combat the "lazy runner" in rugby union**

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*Keywords: rugby, rules, notation analysis*

The effects of rule changes on a sport cannot be objectively determined unless there is some form of measure associated with it. Notational analysis may be used to objectively gauge the effect of any rule change within any particular sport. In 1999, the International Rugby Board, after a conference on the game that consisted of leading international coaches, referees and administrators introduced a law that they believed would rectify a perceived problem in the area of the breakdown. The problem centred on players returning to an onside position from an offside position, when a ruck or maul (breakdown) had formed in open play. To combat this problem a new law was introduced to ensure that players must enter the breakdown from an onside position, thus ensuring cleaner ball. Play at the breakdown is examined to determine the effect of the new law.

The given hypotheses were tested with reference to the Six Nations (n= 10 in 1999 and n=15 2000-2002) and Tri Nations (n=6) over a period of 4 years, between 1999 and 2002. Data captured from the year preceding the law change (1999) was compared with the three following years. The data was collected using a real-time data capture system, which has been written for the notational analysis of rugby union. This system has been tested for reliability using percentage differences for inter- and intra- operator reliability. Error percentages of less than 5%, were considered acceptable given the analytical goals of the study.

Using Kruskal-Wallis and a post-hoc application of a Mann-Whitney test, it was found that there was a significant difference ( $H < .05$ ) in the 3 years after the introduction of the new law change, both in the number of breakdowns and number of rucks and mauls considered unplayable. The law change also resulted in a significant decrease in the number of rucks and mauls that were considered unplayable and unlike the number of rucks and mauls in a game this figure is continuing to decrease every year. A significant difference was found with the percentage of all rucks and mauls lost for the first two years after the law change, with a decrease in ball won against the team in possession. However, no significance was found in the final year when compared to the season preceding the law change.

## P11W-16

**The vision of future of the senior undergraduate students of physical education at the Catholic University of Curitiba - Brazil**

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*Keywords: physical education, undergraduate students*

According to De Masi (2000), the vision of future includes the tendencies and perspectives which the society will be influenced in the next future when the people will work less and they will have more free time. The main objective of this study was to verify the vision of professional future of the senior undergraduate students of physical education at the Catholic University of Curitiba-Brazil, after getting their degree in January 2003.

The data were collected through a questionnaire applied to 110 senior students. The results showed that 41% of the students believed that there will always be a job opportunity for physical education majors, considering that the society nowadays, is well concerned about the importance of the use of the free time practicing sports and physical activities in order to get a better quality of life. When asked about the influence of the media, 45% stated that this is a positive aspect because stimulates the people to work out, thus enlarging the job positions and increasing the value of the professionals of the physical education major. Also, it is important to say that 37% of the students believed that although the job opportunity is improving out of elementary and high school area, there is a great lack of interest in teaching regular classes of physical education for both public and private schools, respectively. Believing that the society searches for a very high qualified professional, 48% of the students showed that they were conscious of the need of a constant upgrade in their new career due to the relationship with the clients is based upon the efficacy the work done by them.

The results demonstrated that the senior students were able to interpret the tendencies which they will be included in during the near future, when they will have to work to benefit a society that has become more exigent to itself and also to consolidate them as a professional of physical education at the beginning of the century 21st.

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**Poster Session****Training and Testing 7 – Communication 1 - Philosophy 2 – History 1 P11X**

## P11X-01

**Motor skills, spinal form and function in healthy school children aged 12 to 14 years**

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*Keywords: motor abilities, adolescents, spine*

Motor skills, spinal form and function of 200 children aged 12-14 years (117 girls, 83 boys) were examined in a cross-sectional study. Aim of the investigation was the collection of data with regard to neuromuscular functions and form and

motion of the spine. The results of the motoric tests were correlated with somatic data (age, weight, and height), gender, weekly media consumption and sports. Test items consisted of standardized analysis systems (Biodex Stability System, bilateral foot tapings, Zebris CMS System, IPN Back Check), the Munich Fitness Test and a standardized questionnaire. Significant correlations were found between somatic data, gender, media consumption, sports and the test results. Children need more physical exercise in their development to prevent civilisation diseases and chronic low back pain in later life.

## P11X-02

**Differences between basketball players on three basic positions in terms of two anthropometric and six motor variables****Vuckovic Goran, Dezman Brane, Erculj Frane**

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*Keywords: basketball, anthropometry, motor activity*

In the European championships for young men in the years 1998, 2000 and 2002, the Slovene national basketball selections ranked second, first and sixth respectively. The purpose of this study is to show the differences between 15 guards, 8 forwards and 10 centres, who were tested at the Faculty of Sport in Ljubljana before each European championship in terms of two anthropometrics and six motor variables.

Out of an extensive battery of anthropometric and motor variables two anthropometric (Body Height, Body Weight) and six motor variables (Vertical Jump, Sprint 20 m, Run-slide-run, Dribble with Changing Direction, Dribble and Passing, Run on 800 m in a hall) were selected. The data was analysed with one-way analysis of variance.

We have established that there were statistically significant differences between the players on different positions in terms of selected variables. In most of the motor variables the best results were achieved by the guards, followed by the forwards and the centres, while in terms of body height and weight the situation was the other way round. The results may serve as one of the criteria for assessing the morphological adequacy and motor preparedness of the future young men national-team players.

## P11X-03

**Document analytic description and review of efficiency in a squad system****Schimanski Maren, Lames Martin**

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*Keywords: squad system, document analysis, squad transitions*

The concept for the young talents in competitive sports (Deutscher Sportbund, 1999) is the bases of the young people's support by the DSB (German Sports Federation). Crucial point in this is the integrative system of squads, which structures the training of the young athletes in the different types of sport (Hohmann et al, 2002). In the following study we implement an analysis of the squad system of the German Golf Federation. The databases are the squad lists, ranking lists and the result lists of the German Championships for the last thirteen years. Via a document analysis the number of squad members in their development over this period as well as the critical transitions between the particular squad levels will be quantified. This is led by the assumption that there are structural reasons that cause the athlete to give up or to interrupt his career at certain age groups or squad levels. To specify these transitions, we analyse the dropout rate, the re-entries and the lateral entries. So we get indications for squad level transitions.

On the database provided by the German Golf Federation from 1990 till 2003 a total survey of the squad development is pursued by means of a document analysis. The development will firstly be specified by frequency distributions. Using transition matrices the characteristics of the squad transitions are then analysed within the several year and age groups.

The document analysis of the Golf squad system provides important insights in its structure and efficiency. The number of squad members is specified in an exact way, critical transitions are quantified and then analysed with qualitative methods. Such an analysis provides many clues about the efficiency of the advancement of young athletes and shows first starting points for an improvement.

*Deutscher Sportbund (1999). Nachwuchs-Leistungssport-Konzept*

*Hohmann A et al (2002). Einführung in die Trainingswissenschaft*

## P11X-04

**Differences in body composition and physical performance depending on training load in young cross-country skiers****Randakova Ruzena, Bunc Vaclav, Kalous Jiri, Slaba Rudolf**

Faculty of Physical Education and Sports, Charles University, Czech Republic

*Keywords: body composition, physical performance, cross-country skiing*

The aim of this study is an assessment of relation among body composition and physical performance in young cross-country skiers. At the same time the objective of this study is to determine the differences in body composition and in level of physical performance, depending on correctness of training program, meaning an individual change of training load after six months training period in a group of Czech young cross-country skiers (n=26) differing in age ( $12.7 \pm 1.5$  years) and fitness state ( $VO_{2max}.kg^{-1} = 63.2 \pm 6.8$  ml.kg<sup>-1</sup>.min<sup>-1</sup>).

Multi-frequency BIA method (B.I.A. 2000M, Data Input, Germany) was used for determination of body composition. The adaptation to a physical training was determined in the laboratory conditions during a progressive running test until subjective exhaustion on the treadmill with a slope of 5 %, initial speed was increased each minute by 1 km.h<sup>-1</sup>.

We found the significantly increase in the level of physical performance and significant differences in body composition, both in most of the parameters and subjects, especially body fat reduction ( $-1.6 \pm 2.2\%$  -  $p < 0.01$ ) and increase of body cell mass ( $2.4 \pm 18.7\%$  -  $p < 0.01$ ); ratio of extracellular mass and body cell mass was decreased ( $-3.7 \pm 6.9\%$  -  $p < 0.01$ ). Maximal oxygen uptake increased significantly by  $4.9 \pm 7.8\%$  ( $p < 0.01$ ) of initial value. Presented differences were all mainly caused by the physical exercise during the six months training period. The most significant relation are between the body cell mass and age ( $R^2 = 0.5537$  -  $p < 0.005$ ), at the same time between the differences of body mass and body mass index ( $R^2 = 0.4943$  -  $p < 0.005$ ), and between the differences of body mass and fat free mass ( $R^2 = 0.3983$  -  $p < 0.005$ ). No significant relation was found directly among the differences in body composition parameters and differences in physical performance variables, although that could be expected. In addition we can recognize that some of our subjects have the high level of adaptation to a physical training ( $VO_{2max} = 73.8$  ml.kg<sup>-1</sup>.min<sup>-1</sup>) and the low level of body fat (BF=12%).

## P11X-05

**Detecting individual heart rate values for aerobic training based on heart rate variability measurements**

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**Keywords:** heart rate variability, aerobic training, field testing

Vagally mediated beat-to-beat R-R interval fluctuation vanishes at the exercise intensity level of 60-70 % of maximal heart rate (HR) in healthy subjects. The Polar HR monitors provide individual HR levels for aerobic training based on the behavior of the HR variability during exercise. The individual HR value for training (OwnZone low limit) is reliable detected during a field test including 10 min walk-jog-test with 2 min speed increments. We tested the hypothesis that the individual HR values for training based on the beat-to-beat R-R interval fluctuation are able to detect reliable during a rapid 5 min walk-jog-test with 1 min speed increments.

Healthy sedentary subjects (BMI<30) were recruited to the study (n=17, age 42±5 yr, 8 females and 9 males). The subjects performed a graded maximal exercise test by bicycle ergometer, starting at 25 W followed by a work rate increase at a rate of 25 W every two minutes until exhaustion. The field tests to detect OwnZone HR values were performed in an indoor hall 2-3 days after the maximal test. The regular test included 10 min walk-jog-test with 2 min speed increments and a rapid test included 5 min walk-jog-test with 1 min speed increments. The field tests were performed in a random order and a 20 min recovery between the tests. The individual HR values, where beat-to-beat R-R interval fluctuation vanished, were detected by Polar HR monitors (Polar M52 for the 10 min test and Polar M61 for the 5min test).

The maximal oxygen uptakes (mean±SD) were 38±10 and 28±3 ml·kg<sup>-1</sup>·min<sup>-1</sup> for male and female subjects, respectively, and the corresponding maximal HR were 186±7 and 169±10 bpm. There were no significant differences in the HR values, where the beat-to-beat HR variability vanished, between the regular and rapid testing protocols. The mean OwnZone HR values were 116±7 and 116±8 bpm for females in the 10 min and 5 min test, respectively (62±4 and 62±4 % of maximal HR). The corresponding values for males were 117±11 and 117±13 bpm (62±6 and 63±7 % of maximal HR).

The individual HR values for aerobic training can be reliable detected based on the behavior of HR variability during dynamic exercise. The rapid field test during 5 min incremental protocol from walking to jogging with 1 min speed increments is a reliable test to detect individual HR values for aerobic training in sedentary healthy subjects.

Tulppo et al (1996). *Am J Physiol* 271: H244-H252

Tulppo et al (1998). *Am J Physiol* 274: H424-H429

## P11X-06

**Effects of concurrent endurance and explosive strength training on neuromuscular performance characteristics and aerobic capacity in endurance athletes**

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**Keywords:** endurance training, strength training, neuromuscular characteristics, endurance athletes

This study investigated the effects of concurrent endurance and explosive strength training on EMG and force production in well trained endurance athletes.

Eight experimental (E) and 11 control (C) cross-country skiers trained for 8 wks. The total training volume was kept the same, but 27% of the training in E and 2% in C was replaced by explosive type strength training (ETST). Dynamometers were used to measure maximal bilateral concentric and isometric force and force-time parameters of the leg extensors and maximal force of the trunk muscles. Surface EMG-activity was recorded from the vastus lateralis (VL) and vastus medialis (VM). The sport specific rapid force production was measured by performing a 30 meter double poling test with the maximal velocity on roller skis on indoor track. Maximal oxygen uptake was determined during the maximal treadmill walking test with the poles.

Maximal concentric force did not change in E and C. In E the force-time curve in the absolute scale tended to change ( $p<0.06-0.10$ ) so that the times to reach lower force levels (0 - 750 N) shortened. Correspondingly, the early absolute forces (0-100 ms) in the force-time curve increased in E by  $18 \pm 22\%$  ( $p<0.05$ ). In E the AEMG in the early portions (0-100 ms) of the isometric actions increased in VL by  $21 \pm 21\%$  ( $p<0.05$ ) and in VM by  $27 \pm 32\%$  ( $p<0.1$ ). In E the relative changes in the early AEMG of VL (0-100ms) correlated with the relative changes in the early forces (0-100 ms) ( $r = 0.86$ ,  $p<0.01$ ). No significant changes were observed in C in the EMG or force-time variables. Maximal isometric force of trunk flexors and extensors tended to increase in E ( $6 \pm 9\%$ ,  $5 \pm 7\%$ ; ns) and to decrease in C ( $-2 \pm 16\%$ ,  $-1 \pm 11\%$ ; ns). Maximal double poling speed remained unchanged in both E ( $1.4 \pm 1.6\%$ ) and C ( $0.3 \pm 1.3\%$ ), but the relative changes in double poling speed between the groups showed a borderline significant difference ( $p<0.1$ ). No significant changes occurred in VO<sub>2</sub>max either in E or C.

The present 8-wk ETST resulted in considerable improvement in explosive strength of the leg extensors, although a large volume of endurance training was performed concomitantly. This supports previous findings that in well-trained endurance athletes training-induced improvements in neuromuscular performance may not be fully inhibited by concurrent explosive strength and endurance training. Our data further showed that the increase in explosive strength occurred primarily due to neural adaptations.

## P11X-07

**Evaluation of a new ergometer cycle test for estimating the maximal oxygen uptake**

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**Keywords:** testing, maximal oxygen uptake

To determine the levels of maximal oxygen uptake demands a complex and costly instrumentation. This has stimulated



attempts to develop more simple and non-expensive tests that estimate the levels of maximal oxygen uptake. One such example is the submaximal cycle ergometer test (Astrand & Rhyming 1954; Astrand, 1960). That method results, however, in values which are rather insecure. This uncertainty applies also to other tests for estimating the maximal oxygen uptake. It was therefore considered valuable to scrutinize if it is possible to attain a more secure and, at the same time, simple method.

The principle of the new test is dependent on: (1) the relationship between submaximal workloads and heart rate at steady state, and (2) the maximal heart rate. These measures are attained through exercise on a mechanically braked Monark cycle ergometer (Varberg, Sweden). A line depicting (1) is drawn to the value of the maximal heart rate. From that point a vertical line is drawn down to the x-axis representing the work load. The work load crossed by the vertical line is "translated" into the corresponding average oxygen uptake. This value is taken as the estimated maximal oxygen uptake. To evaluate the new test, 9 physically active men (age: 25±5yrs) performed three submaximal and one maximal work load on a Monark cycle ergometer. This procedure was repeated on two different days. Heart rates were recorded and the oxygen uptakes measured with different days. Heart rates were recorded and the oxygen uptakes measured with the Douglas bag method. For the statistical analyses a one factor ANOVA for repeated measures and the Scheffé F-test were used.

The new test resulted in on average 3 and 5% lower values than the measured maximal oxygen uptake, whereas the Astrand test with age corrected values resulted in 12 and 13% higher values, which were significantly different compared to both the determined values and those estimated through the new test.

The evaluation indicates that the new test can be a reasonably valid and reproducible method for attaining a value on the maximal oxygen uptake.

Astrand, P-O & Ryhming, I (1954). *J Appl Physiol* 7:218-221  
Astrand, I (1960). *Acta Physiol Scand*, vol 49, Suppl 16925: Physiology

#### P11X-08

### Changes of selected anthropometric and physiological variables in elite sprint runners during the year

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*Keywords: anaerobic capacity, running, bioimpedance*

The aim of this study was to assess changes of selected anthropometric and physiological variables regarding anaerobic energy metabolism during the training year in high performance athletes - sprint runners.

Fifteen male subjects, top trained Czech junior and senior runners (400 m and 400 m hurdles), were tested (mean age=21.7±2.5 years, height=182.1±6.03 cm, body mass=73.4±5.9 kg, body fat=9.63±1.69 %, extracellular mass/body cell mass (ECM/BCM) = 0.70±0.07- data from the 1st evaluation). We measured the physiological maximal and submaximal variables by the Kindermann-Schnabel test on the treadmill. We measured the time to exhaustion in maximal part of test, heart rate ((HR) - was recorded by the heart rate monitors during the whole test), the blood lactate concentration (in 3rd minute after submaximal part of the test, before maximal part of the test, and after maximal part of the test in the 3rd, 5th, 9th and 15th minute). The 1st

evaluation was in the preparatory period (January, February), 2nd in the precompetitive period (April, May).

The anthropometry variables in the preparatory and precompetitive period were not significantly different, except ECM/BCM ( $p<0.01$ ): body mass  $73.4 \pm 5.9$  kg and  $72.1 \pm 5.2$  kg, body fat  $9.6 \pm 1.7$  % and  $9.3 \pm 1.6$  %. ECM/BCM was significantly changed:  $0.70 \pm 0.07$  and  $0.67 \pm 0.06$ . The time to exhaustion reached in maximal part of the test increased from  $69.4 \pm 6.7$  s to  $77.7 \pm 9.5$  s, it is improvement about 12% in mean values ( $p < 0.01$ ).

The significant changes have been found neither in the maximal variables of the HR nor in recovery phase after submaximal and maximal part of the test. The nonsignificant changes in the blood lactate concentration have been found, that shows no improvement in short-term recovery processes. The results of the study indicate smaller differences in anthropometry variables during the year, probably this is result of long-standing training. The initial variables in the preparatory period were above - average and have stayed above-average till the end of the period. The training had positive effect on the time to exhaustion reached in maximal part of the test.

#### P11X-09

### Differences between playing positions in some motor ability tests of young female basketball players

**Erculj Frane, Dezman Brane, Vuckovic Goran**

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*Keywords: basketball, motor testing, females*

The modern basketball model is based on quick, aggressive and diverse play in offence and defence. Such playing gets more present in female basketball. This playing model favours those individuals that are capable of realising multiple playing roles. In the current study we shall therefore try to analyse in more detail the differences between female basketball players holding different playing positions.

For this purpose we used a sample of six variables (motor tests), with which we measure some specific motor abilities and technical knowledge of young female basketball players (speed in ball dribbling, agility in ball dribbling, special coordination (technique) in ball dribbling and passing, speed in ball passing, explosive arm power). We measured 90 cadet female basketball players (46 guards, 24 forwards and 20 centres). The sample included practically all the best Slovene female players, 15 or 16 years of age, who were members of the Slovene national selection in the last five years.

The results show that the differences between subjects are quite large in most tests. Inspection of the differences between playing positions, that is the different types of players, show that they are statistically significant in four out of six tests.

Considering these results it may be established that the outside players (guards) are better in fast dribbling and dribbling with direction changes, and obviously they employ much better the technique of dribbling at a high speed and with direction changes. It may also be established that there are no differences between individual types of female players in terms of speed in ball passing and explosive arm power. In view of the achieved results we have every reason to believe that tall female players who were included in the sample are not capable to play with quality at the positions of the outside (shorter) players. Considering the fact that Slovenia constantly lacks extremely tall female basketball players, the results of our study are not pleasing. By all means, the training of tall female players in the future should focus more

on developing those abilities and knowledge which could help the players increase their universality. Consequently we hope, the results of the national selections will be better.

#### P11X-10

### "Actuality versus background" - A comparison in the Olympic coverage between a quality newspaper and a yellow press paper

**Sattlecker Gerold, Dimitriou Minas, Müller Erich, Renger Rudi**

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*Keywords: Olympics, newspapers*

The study should show the differences between the quality newspaper „Der Standard“ and the yellow press paper „Neue Kronen Zeitung“.

The method used was a content analyses including quantity aspects (category scheme) and quality aspects. The two Austrian newspapers were compared while their reporting of the Olympic Games in Salt Lake City (8.-24. February 2002). In three of the six categories (interactivity, actuality and ethic) the „Kronen Zeitung“ had better results than the „Standard“. The other three categories (sources, performance and background) showed the expected results as there were advantages for the high quality newspaper.

As a conclusion it was to see that the „Kronen Zeitung“ had most of the time very good results concerning the six selected quality-categories. Obviously this is a result of the importance of the sports resort in this newspaper.

#### P11X-11

### History of life saving swimming techniques in Italy

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*Keywords: swimming, life saving*

Modern life saving was born in Europe at the end of 1800's. Since then the swimming techniques as in the competitions were the same used for life saving actions and being differentiated in swimming to get closer to the person and swimming for transportation. At the beginning of 1900's these swimming techniques were described and classified by Anglo-Saxons experts. During this past 100 years, there has been a distinct differentiation between the techniques for pure swimming, also adopted by the Olympic competitions, that is crawl, back stroke, breast stroke and butterfly (?), and those techniques taught during the life saving training courses. These courses are taught to water safety rescuers and organized by National Organizations and Federations, associated with the Life Saving Federation of Europe.

The authors have analyzed the techniques of side-stroke, over-arm, trudgen-stroke, crawl-stroke, and back-stroke, illustrated in Italian and European Manuals of the beginnings of 1900's. Furthermore, the old techniques have been compared to the present techniques described in the Manuals adopted by the National Federation of the United Kingdom, Germany and the Italy, affiliated to the International Life Saving Federation of Europe.

The swimming techniques described in the manuals and documents of early 1900's including side-stroke, over-arm,

trudgen-stroke, crawl-stroke, and back-stroke do not have received any substantial changes in the last 100 years.

The evolution of swimming techniques used both in competitions and for saving activities since the end of 1800's were already the result of a careful study and understanding of the use of the swimming, and therefore their application in water saving have not been subjected to any major change in this past 100 years.

#### P11X-12

### To phenomenology of performance in sport

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*Keywords: phenomenology of performance*

Corporeality and the problem of evidence. The speech of the body as the source of the evidence of the truth. Greek symbolism of the body and the problem of performance in sport, Dionysian rites and the reason of the body, error of a false causality of sport, the sense of sport in our time. Philosophical significance of performance in sport in this time. It is the search for a philosophy which shall be a rigorous science, but it also offers an account of space, time and the world as we live them. It tries to give a direct description of our experience as it is. The method - transcendental epoche-phenomenological reduction.

The reduction is presented as the return to a transcendental consciousness before which the world is spread out and completely transparent. It is typical also for the body and the performance in sport. We can now consider the notion of intentionality, too often cited as the main discovery of phenomenology. Normal definition of the body is definition of the object, that it exists "partes extra partes", and that consequently it acknowledge between its parts, or between itself and other objects only external and mechanical relationships, whether in the narrow sense of motion received and transmitted, or in the wider sense of the relation of function to variable.

Bodily experience is evident and gives to us the possibility of certainty - evidence for all our life. This experience is intentional, it means, not Cartesian.

The body must be apprehended not only in an experience which is instantaneous, peculiar to itself and complete in itself, but also in some general aspect and in the light of an impersonal being. It is very important for the performance in sport, for the body and for the speech of the body.

The problem of evidence is the problem of analyse of time. The performance in sport constitutes the present time as the basis of evidence in the life. Protention, retention and urimpression are basic elements for understanding of this problem. It is in my field of presence in the widest sense - this moment plays very important role.

*Merleau-Ponty, M. (1996) Phenomenology of Perception. London: Routledge and Kegan Paul, 1996.*

*Patocka, J. (1996) Péče o duci I. Praha: Oikumene 1996.*

*Husserl, E. (1972) Krize evropských ved a transcend fe.*

## P11X-13

**"Beijing awarded 2008 Olympics": the "Olympic opposition" and the political background of the voting in Moscow**

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*Keywords: 2008 Olympics, political background*

The International Olympic Committee's decision to award the hosting of the 2008 Games to Peking has unleashed a wave of enthusiasm in China. International reaction to the IOC's decision, however, ranges over a broad spectrum. The aim of this study is to analyse the political background of the decision to hold the 2008 Olympics in Beijing.

The literature review which includes the study of print and online media, official IOC documents and press releases regarding the voting procedure of Moscow and statements of the so called 'Olympic opposition' against China and Beijing illustrates that the political importance of the games. China itself recognised that sport was not above politics when it criticised the decision to stage the 1980 Games in Moscow following the Russian invasion of Afghanistan. The Chinese leadership must grasp the Games as an opportunity for political change, but not as a license for human rights abuses.

## P11X-14

**Sport and religion: impulses and relevance to develop and implement a novel field of sports investigation**

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*Keywords: religion, sport investigation*

The sport sciences, which deal with the very dynamic and still imprecise phenomenon of sport, have a need to discuss the various aspects of what may be defined as 'sports' and have to be open to new ways of enquiry as well. While it is not a traditional pairing, this paper suggests that sport and religion may be integrally intertwined. By broadening the research perspective and the approaches to the study of sport in this way, solutions may be found which may aid in the clarification of the ethical questions and problems which now confront international sports and physical education in multicultural societies.

Differing from former studies about sport and religion, which focused on western sport and Christianity, here a more open perspective is preferred. The main part of this investigation involves text analysis and qualitative-discursive interviews. It shall focus on the resemblances between religion and sport. Sport and religion have some common grounds which warrant challenging this field of investigation. Both sport and religion are similar as core elements of most culture systems; they regard the human being in its entirety and create "time-outs" from everyday life stress. Both include rituals in a similar way. They are social institutions which can convey norms and meaning and both are engaged in general social life. Both have been considered and "used" as state religion/ folk religion or state sport/ folk sport and have been abused by political exploitation.

It is obvious that there is a need to have a closer look at this field of research in sport science and physical education. In addition, the progression of globalization in the world of sport and the increasing influence of both sport and religions (in their each own special way) should also provoke academic discussion. To be open to new perspectives can aid in the progress in considering and solving some of the ethical problems which sport now faces.

*Coakley J, Sport in Society: issues and controversies. Weis K (1995), Soziologie des Sports. Opladen: Suits B, Philosophic Inquiry in Sport*

## P11X-15

**European Year of education trough sport 2004**

**Velázquez Pedro**

European Commission, Belgium

*Keywords: education, European Year, sport*

Improving the partnership between the worlds of education and sport, making greater use of sporting values in education and integration, and increasing voluntary work in sport are just some of the objectives of the European Year of Education through Sport 2004. This European Year, which coincides with several major sporting events, including the Euro 2004 football tournament in Portugal and the Athens Olympic Games, has been allocated a budget of EUR 11.5 million by the European Parliament and the Council. Part of this budget will be used to support measures and projects, at both Community and local levels, for which the Commission has just published a call for proposals.

The Council and the European parliament adopted the 6th of February 2003 the Decision No 291/2003/EC establishing the European Year of Education through Sport 2004.

The Commission has finalised in May a call for tender procedure and a service contract relating to the information and communication campaign has recently been signed.

Concerning funding opportunities in the frame of the EYES 2004, a budget of EUR 6.5 million has been allocated to cofinance measures formulated in the Member States and implemented at local, regional, national, international or Community levels. The procedure, which will cover the period up to 31 December 2004, will consist of three rounds. The first round has a budget of EUR 500 000 and will cofinance measures beginning before 1 January 2004. The deadline for submission of applications is 4 July 2003. The second round will cofinance measures beginning between 1 January 2004 and 30 June 2004, providing up to a total of EUR 4 000 000. The deadline for submission of applications is 1 October 2003. The third round is reserved for measures which must begin on or after 1 July 2004. The deadline for applications is 1 March 2004 and the total available is EUR 2 000 000.

Community-wide projects (partners from at least eight Member States) may receive cofinancing of up to 80% of the total cost of each project and will be selected by the Commission.

Projects which are local, regional, national or international in nature may receive cofinancing of up to 50% of the total cost of each project. These projects will be selected at national level by the national coordinating bodies for the European Year 2004.

*Text of the call and list of national coordinating bodies available on: DG Education and Culture (Sport Unit)*

## Poster Session

## Biomechanics 3

P11Y

P11Y-01

**ADL-monitoring: Optimized interaction between the dynaport ADL-monitor and the step-activity-monitor (SAM) for assessment of patient activity****Brandes Mirko, Rosenbaum Dieter**

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*Keywords: ADL-monitoring, step activity monitor*

Many methods are available to assess activities of daily living in humans with regard to quality of life or outcome after clinical interventions. If direct observation is not feasible, mobile devices can be used instead. To reduce restrictions, investigators have to minimize the burden for the patients induced by the measurement devices.

The aim of the present study was to determine the relationship between the DynaPort ADL-monitor and the SAM. If satisfying correlations are found, the days of wearing the ADL-monitor can be reduced without losing descriptive power of the results. Restrictions and technical problems caused by the measurement devices were assessed by questionnaire.

Nine subjects (24 - 49 yrs.) wore both devices simultaneously during waking hours (duration: 13.9 hours) on two separate working days. Subjects filled out the questionnaire the day after each assessment with visual analogue scales with respect to restrictions and problems. Besides descriptive statistic spearman correlation was calculated between parameters assessed by the ADL-monitor and the number of steps assessed by the SAM.

One subject has been dropped out of the study, so that the results are based on 16 trials. We found correlations of 0.95 ( $p < 0.01$ ) between percentage of locomotion (POL) and number of steps, 0.71 ( $p < 0.01$ ) between Physical Activity Index (PAI) and number of steps and 0.76 between PAI and POL. No limitations were declared by one subject, minor limitations by six subjects and few limitations were mentioned by one subject. Technical problems were reported by two subjects. No significant differences between both assessed days of each subject were found.

The results underline the possibility to relate the number of steps to activities of daily living. Therefore, additional step-counting validates the POL assessed by a single day of ADL-monitoring. Thus, additional days of ADL measurements are not required. So if intensity and POL is targeted, one day of simultaneous measuring using both ADL-monitor and SAM followed by further days using only the SAM delivers valid results.

The lower correlation between steps measured by the SAM and the DynaPort PAI is explained by the calculation mode of the PAI. Not only locomotion is considered, but also the percentage of lying, sitting and standing.

P11Y-02

**Development of mechanical effectiveness of the soccer kick in children****Marques-Bruna Pascual, Lees Adrian, Scott Mark**

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*Keywords: mechanical effectiveness, child development, soccer kick*

In the game of soccer, there are a number of situations that require the junior player or goalkeeper to kick the ball to a long distance. Mechanical effectiveness of the maximum-distance soccer kick can be assessed with reference to specific principles of movement (Bunn, 1972; Lees, 1999); however, previous descriptive research in motor development has rarely attempted to analyse the mechanical characteristics of the kicking action observed in children. Therefore, this study assessed mechanical effectiveness of the maximum-distance soccer kick and its course of development in a group of school-aged children.

The kicking effectiveness of a group of 187 children (106 males and 81 females; aged 5-11 years and a control group of 21 adults (15 males and 6 females; mean age =  $22.3 \pm 6.8$  years) was assessed using a qualitative model of movement effectiveness developed for the purpose. The model was used to select 15 technique and 4 performance variables directly related to kicking performance. Kicking effectiveness of the subjects was rated on each of these variables on a scale of 0-4 using video analysis. Spearman's Rho tests were carried out to analyse the relationship between the median of scores for each variable and age of the children in order to study developmental trends ( $p < .05$ ). Gender differences in kicking effectiveness were also assessed.

Descriptive graphical data showed distinct gender differences in kicking effectiveness for most variables. Results of the Spearman's Rho tests showed a significant positive correlation between mechanical effectiveness and age of the children for 12 technique variables and 1 performance variable in males and for 5 technique variables and 1 performance variable in females.

The findings of this study suggest that, while previous research has been descriptive in nature, the understanding of kicking development may benefit from considering detailed analysis of the mechanical effectiveness of the kicking action observed in children.

*Bunn JW (1972). Scientific Principles of Coaching**Lees A (1999). The National Coaching Foundation*

P11Y-03

**The effect of triteness of the slalom ski course****Supej Matej, Kugovnik Otmar, Nemec Bojan**

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*Keywords: slalom, triteness, kinematics*

The paper deals with the effect of triteness of the slalom ski course.

We took the slalom course during trainings of top-level slalom race members of the Slovenian national Ski team. They have performed 3 runs each on the same course set-up. All

together we have recorded 14 runs. The air temperature was +3°C and the snow was well prepared and hard in the morning but getting soft as planned since the weather was warm enough to enable our study.

Standard 17-point 3D kinematical measurements have been performed with 4 camcorders with 50 frames per second. APAS Ariel 3D kinematical software has been used for trajectories capturing. Captured trajectories were analyzed using our own developed software system KinSki, which enables an analysis of videos and over 30 calculated parameters essential for skiing simultaneously.

The essential parameters in our study were CG (center of gravity) and AMS (arithmetic mean of skies).

It turns out that the most important parameters that show the effect of triteness of the slalom ski course are the points of the beginning and the points of the end of the turn. They are in average constantly lowering with the skiers' passing through the gate combination. The linear coefficients of the both trend lines are 0.055m/run and 0.11m/run for the beginnings and for the ends of the turns respectively. Similar results are obtained observing displacements of the beginnings and the ends of the turns and prolongation of the CG and AMS trajectory according to the skiers' runs. In this case the linear coefficients are -0.0033m/run and 0.046m/run for the beginnings and for the ends of the turns respectively. Furthermore the average velocities trend line coefficients for CGs' and AMSs' are both 0.052ms<sup>-1</sup>/run that shows that the skiers have even skied slower after each passing.

Almost all observed parameters show differences and make it clear that such conditions since we have measured also in average 0.01s under difference in times for the inspected turn after each passing through the gate combination.

#### P11Y-04

### Changes on the take-off phase of 400 m hurdle clearance induced by anaerobic fatigue

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*Keywords: fatigue, muscle-tendon unit, kinetics*

The 400 meters hurdle running involves a velocity effort at maximum intensity, which requires an excellent level of anaerobic capacity and muscle power. To maintain the best performance during the last phases of the running, the athlete muscle-tendon complex should maintain a high level of power output and muscle stiffness during the support phase. The purpose of this study was to investigate changes on the mechanical power output variables produced by the muscle-skeletal system on the take-off phase of hurdles clearance, induced by a specially designed fatigue protocol which was intended to simulate the fatigue condition of the 400 meters hurdle.

Seven national elite male athletes participated in this study. The take-off action was high-speed video recorded at 250 Hz. 2D joint, and body center of mass (BCM) kinematics data were calculated. The regression equations adapted by Jacobs, et al. (1996) were used to estimate the behavior of the muscle tendon complex of the athletes support leg. A force platform was installed on the track, and the ground reaction forces were recorded electronically synchronized with video data. These procedures were repeated before and after a fatigue protocol. The differences were tested using T-Tests for paired samples.

The effectiveness of the fatigue protocol (FP) was verified comparing the blood lactate concentration (BLC) obtained at the end of that protocol with the blood lactate concentration

obtained on the National Championships (NC) held two days before. Four of the tested athletes were compared (BLC: NC 17.83±3.12; FP: 17.25±3.17, p-value 0.15).

In fatigue conditions there was an increase of the total contact time, due to a significant increase of both breaking and propulsive contact times. However, ground reaction forces did not show any significant changes. This fact was associated to a substantial reduction of the horizontal velocity of the BCM. The increase of the support time comes with the increase of the duration of the VL and SOL eccentric phase followed by an increase of the duration of the concentric phase and the shortening amplitude of triceps surae muscle. The described data points out to the assumption that the athletes spend more time on the ground because the leg extension muscles have less capability to produce mechanical power during the shortening phase. Finally, as the athletes can't produce higher propulsive impulses they loose horizontal velocity.

Jacobs R, Bobbert M. F, & van Ingen Schenau G (1996). *Journal of Biomechanics*, 29(4), 513-523

#### P11Y-05

### The effect of foot orthotics in the ski boot on electromyography muscle fatigue

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*Keywords: EMG, orthotics, fatigue*

De Luca (1997) stated that as muscular fatigue occurs, there is a decrease in the frequency of the firing rate of the muscle and this is evident in the frequency output of the electromyogram (the power density spectrum). Muscular fatigue in the lower limbs is a problem commonly experienced by skiers. Manufacturers of foot orthotics claim that they can reduce muscle fatigue during skiing (Superfeet Worldwide LLC, 2001). The skier's squat mimics the tuck position the downhill skier aims to maintain in a controlled fashion for as long as possible. The aims of this study were to determine whether electromyography (EMG) was a reliable method of analysing fatigue in the vastus lateralis (VL) during a skier's squat and whether foot orthotics in the ski boot could reduce muscular fatigue in this situation.

Surface, bipolar, active EMG electrodes were applied to the VL of 6 experienced skiers. EMG activity was recorded continually as the participants performed a skier's squat for as long as possible under three conditions: high volume Superfeet Synergizer® Green Capsule foot orthotic, low volume Superfeet Synergizer® Blue Capsule foot orthotic and no foot orthotic (control condition). The two orthotics differ in that the Green Capsule is made from 50% more foam and more ideal for high volume shoes (Superfeet Worldwide LLC, 2001). The knee angle was monitored using a goniometer and each squat was timed (mean, ± s; 117.6 s, ± 3.7 s).

There was no difference in the duration of the squats across conditions (p < 0.05). Overall, EMG power density spectrum analysis revealed a decrease in the median frequency values in the last 20 seconds of the squat (p < 0.05), suggesting that fatigue was occurring and was measurable using EMG. Within conditions, the low volume and the control condition displayed a reduction in the median frequency of the power density spectrum in the last 20 seconds (p < 0.05). However, no fatigue effect was evident in the EMG analysis for the high volume orthotic condition. This may suggest that fatigue occurred in other muscles or due to other biochemical variables.

In conclusion, the results indicate that the foot orthotics used in this study provide no significant increase to the duration of the skier's squat.

De Luca, C. J. (1997). *JAppl. Biomech*, 13: 135-163.  
Superfeet Worldwide LLC (2001). *Superfeet Synergizer Footbeds*. Retrieved March 15, 2002, from <http://www.superfeet.com/product/trimtofit.html>

#### P11Y-06

### Work efficiency of knee extensors applying different amount of stretching energy

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**Keywords:** efficiency, stretch-shortening cycle, energy

To improve explosive strength of the lower extremity muscle drop jump is the most commonly used drill. Researches tried to find the optimum dropping height that can be applied to the athletes. We investigated the effect of the stretching energy (SE) on muscle torque and angular displacement during eccentric phase and its effect on the subsequent concentric phase. We hypothesized, that there is an optimum SE at which the muscle work efficiency is the highest.

23 healthy, male university student volunteered to the experiment (age: 25.5 SD: 4.7 yr., body mass: 80.3 SD: 8.5 kg, & height: 1.85 SD: 6.34 m). First of all we measured maximum isometric torque (M0) at knee angles of 50, 60, 70 and 80 degs. on a computerized dynamometer. After the subjects exerted 0.5M0 at 50 degs., and after reaching it, the driver of the dynamometer started to flex the knee joint immediately. We applied various level of SE (60J, 90J, 120J, 150J or 180J). The subjects had to resist to the stretch with the highest effort and stop the flexion as soon as possible. After the knee flexion the knee extension occurred automatically. M0, angular displacement (AD), eccentric torque (Mec), was measured, negative & positive work (Wneg, Wpoz), mechanical power (P), and mechanical efficiency (Eff) was calculated. The means were compared by Student t-test. Pearson product moment correlation was used to reveal relationship between selected parameters.

The AD during eccentric contraction increased linearly in the function of SE. M0 was 345.1 SD: 55.0 Nm at 50 degs. The greatest M0 was measured at 60 degs. The Mec increased in the function of increased SE. The lowest Mec (396 SD: 27.6) was measured at 60J and the highest (433 SD: 56.2) at 180J. The relationship between M0 and Mec was significant. Wneg, Wpoz and P increased linearly in the function of SE. The Eff was significantly less (27.0 SD: 4.0 %) when 60J energy was applied compared it to the other four conditions. At 90-180 J SE the Eff remained unchanged.

We found a range (90-180J) in which the Eff became constant. However, we found linearly increasing Wneg, Wpoz and P in the function of increased SE because of stretch reflex effect and more amount of stored energy.

#### P11Y-07

### Relationship between running economy, flexibility and hypermobility in sedentary females

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**Keywords:** running, hypermobility, flexibility

Previous research has demonstrated a significant inverse relationship between running economy and flexibility in trained males, and more specifically, a relationship between running economy, dorsiflexion, and maximal hip external rotation. No research has, however, investigated whether this relationship exists in females. In addition, the role of hypermobility in running economy has not been examined, and females have a greater tendency towards increased flexibility and hypermobility after puberty. The purpose of this study was therefore to determine the relationship between flexibility, hypermobility and running economy in young adult sedentary females.

Sedentary college-aged female volunteers (n=21) were tested. On day one of testing, selected anthropometrical parameters (height, weight, skinfolds, circumferences and widths) were measured and body composition calculated in accordance to the Heath & Carter method. Joint hypermobility scores were also determined using the Carter and Wilkinson nine-point system. Finally maximal oxygen consumption was measured using an incremental treadmill protocol. On day two of testing hip external rotation and ankle dorsiflexion were determined together with submaximal steady-state O<sub>2</sub>-uptake at 9 km.h<sup>-1</sup> and 12 km.h<sup>-1</sup> respectively on a treadmill. The two testing days were at least 48 hours apart. All measurements were performed without prior warm-up or stretching to eliminate the impact this might have on the validity of the measurements. Results were analysed using a Pearson correlation co-efficient ( $p < 0.05$ ). Surprisingly no significant correlations were found between running economy and flexibility of the ankle ( $r = -0.306$  and  $r = -0.377$ ), and hip ( $r = 0.105$ , and  $r = 0.476$ ) for 9 and 12 km.h<sup>-1</sup> respectively. There was also no correlation between running economy and hypermobility ( $r = 0.236$ , and  $r = 0.254$ ).

Flexibility and hypermobility in sedentary college age females does not correlate with running economy. It is suggested that these factors should be further investigated in endurance trained female subjects.

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Craib MW et al (1996). *Medicine and Science In Sport and Exercise*, 28 (6): 737-43

Jones AM (2002). *International Journal of Sports Medicine*, 23 (1): 40-3

#### P11Y-08

### Evaluation of performance of high level long jumpers based in biomechanical analysis

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**Keywords:** biomechanics, long jump, high performance

The main problem the athletes in long jump have to solve is the reduction of the loss of horizontal velocity and the increase of the vertical velocity in the takeoff if they want to achieve an optimum performance. The purpose of this study

was to identify and assess the kinematic parameters which have the most effect on the individual performance of the high level long jumpers (HLLJ) using theoretical models described in the literature. For this objective it was necessary to develop a method of kinematic analysis of performance variables based on 2d and 3d photogrammetry of all the jump phases and to make a longitudinal measurement of jumper's technique developed in international competitions.

The subjects of the study were one man and two women, Spanish HLLJ. Photogrammetric 3d technique using two digital high-speed video cameras at 250 Hz was developed to analyse last stride (LS), touchdown (TD), takeoff (TO), flight and landing phases. The film was analysed with a 14 segmental biomechanical model and was processed smoothing the data with quintic splines (Kinescan-IBV) and with a software developed in our Laboratory. Statistical procedures used were one sample Student's t in relation with men and women theoretical models developed by Lees et al. (1993, 1994).

The results indicated that only subject 2 has lower duration of Ls than the model. The height mass centre (CM) at TD, at maximum knee flexion (MKF) and at TO are lower in our group, but the difference between height CM MKF to TO, and TD to TO, are higher in subject 1. It indicates that the displacement of CM is more efficiently than the model. The projectile distance is higher in Subjects 1 and 2 indicating a better potential flight phase. The horizontal distance between CM to TD is lower in subjects 1 and 2 indicating a reduced lost of braking distance. The horizontal and vertical velocities of subject 1 are higher than the model explaining the better results of him. The results obtained by Lees et al. (1993, 1994) and Miller and Brüggemann (1997) are in agreement with our longitudinal study data and they have served of reference to evaluate our athletes and identify the variables that could have a negative influence on long jump. In the same way, they enhanced the better values of our jumpers in some variables that explain the higher efficacy of their performance.

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Lees, A.; Fowler, N.; Derby, D. (1993). *Journal of Sports Sciences*. 11, 303-314

Müller, H.; Brüggemann, G. P. (1997). *IAAF: New Studies in Athletics*. 13, 2/3.

#### P11Y-09

### Vastus lateralis muscle-tendon behavior in skating movement

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**Keywords:** ultrasound, speed skating, muscle-tendon behavior

Possible utilization of tendon stretch-recoil makes stretch-shortening cycle action (SSC) to a very efficient form of locomotion (Aura & Komi, 1986). The elastic components of the muscle may also be utilized in push-off after a long static gliding phase in speed skating movement. Therefore, the purpose of the present study was to investigate the interaction of the muscle and the tendon components during the skating movement.

Three national level male speed skaters participated in the study. The subjects roller skated at a velocity of 23 km · h<sup>-1</sup> in treadmill conditions while kinematics, ground reaction force (GRF), and real time ultrasonography and surface EMG of VL were collected. Length changes of muscle-tendon unit (MTU) were calculated using the model introduced by

Hawkins and Hull (1990). Fascicle and tendon length changes were calculated according to Finni et al. (2001).

Knee angle remained constant during the gliding phase resulting in constant MTU length. In push-off phase the MTU shortened rapidly and the knee extended. Fascicles were most active before the powerful push-off began and stretched the tendon component by shortening rapidly. In the first half of the push-off the fascicles continued shortening and the tendon stretched. In the second half of the push-off the fascicles contracted quasi-isometrically and the tendon shortened rapidly. Peak knee joint moment and GRF was produced at the time when the tendon was stretched the most. A negative correlation was found between negative tendon power and peak MTU power.

In accordance to earlier studies (Fukunaga et al. 2000) contractile and tendon components showed a different displacement than the whole MTU. Elastic energy was stored in the tendinous structures during the tendon stretch and recoiled in the push-off phase. The average work done by tendon was 24 % of the total work of MTU in push-off phase. Despite of the static gliding phase in speed skating it was concluded that the tendon stretch-recoil resulted in enhanced mechanical efficiency of skating movement.

Aura O & Komi PV (1986). *Int J Sports Med* 7: 137-143.

Finni T et al (2001). *Eur J Sport Sci* 1, Vol 1.

Fukunaga T et al (2000). *Proc R Soc Lond B* 268: 229-233.

Hawkins D & Hull ML (1990). *J Biomechanics* 5, Vol 23: 487-494.

#### P11Y-10

### Characteristics of external and internal loads of multi-joint tasks - consequences for training control and rehabilitation exercises

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**Keywords:** external loads, multi-joint exercise, training control, internal loads

To understand locomotion patterns in sports and the prevention of overload situations in training, diagnostic and rehabilitation, knowledge of external and internal load parameters is very important. Especially multi-joint tasks of the lower extremity with their high degrees of freedom are not well understood yet. Thus further examination on internal load distribution on muscles and joint-structures or the coordination of the two-joint muscles should be done.

The data were obtained from n=6 male subjects, when extending the lower limb in a leg press with maximum effort at different velocities (0.2 and 0.8 m/s). A three dimensional motion analysis and a three dimensional acquisition of ground reaction forces was done for data collection. A kinetic model (STUCKE 1984, GLITSCH 1992) was applied for the calculation of internal loads in the ankle, knee and hip joints.

It was found that there exists a three-dimensional character of internal loads at all joints of the lower extremity. The maximum torques in the ankle and knee joint are both acting in the sagittal plane, whereas in the hip joint the maximum moment acts in the transversal plane. Thus only a two-dimensional analysis may underestimate internal loads up to 40% in the ankle, 27% in the knee, and up to 65% in the hip joints. Moreover at both steps of velocity there are great differences when comparing ground reaction forces and intersegment moments. These differences between external and internal loads are concerning the temporal position of maxima and the characteristic run of curves and showed that

training loads in sports and rehabilitation do not comply with internal loads. Thus, only knowing the internal load situations on muscles and joint structures when applying multi-joint exercises, can guarantee optimal training effects and the prevention of internal overload after injuries.

The determination of sport specific abilities is of great importance to be able to control them in discipline specific diagnostic-programs. Also in rehabilitation many multi-joint exercises aren't well analysed yet. Further studies should consider various variations of leg extensions and still higher movement velocities. Therefore we enhanced a powerful training and diagnostic machine called IsoMed2000. Moreover, EMG measurements and their data added to our model will help us calculating internal loads on muscles and joint structures and estimating muscular coordination.

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*Stucke H (1984). Zur dynamischen Belastung des oberen Sprunggelenkes und seines Sehnen- und Bandapparates, Dissertation*

#### P11Y-11

### Specific muscle hypertrophy and pitching performance in baseball pitchers

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**Keywords:** baseball, ball velocity, muscle size

The purpose of this study was to clarify the relation between pitching performance and difference of the muscle size on dominant and non-dominant limbs in baseball pitchers.

**Subjects:** Six varsity male pitchers without throwing arm problem were voluntarily participated in this study. Mean age, height and weight were 20.7±1.4 (SD) yr, 171.7±4.3 cm and 66.5±4.5kg, respectively.

**Muscle size measurement:** A cross-sectional view of the muscle for upper and lower limbs and trunk in dominant and non-dominant sides was obtained by Magnetic resonance imaging (MRI) method (Toshiba, Japan). Scanning distance of MRI for each site was kept 20 mm. Each muscle was traced to digitize connected to computer (IBM). Muscle area was calculated by computing program (Image hyper L). Muscle volume index (MVI) was estimated by area times scanning distance for each site. MVI ratio was, also calculated by values ratio of dominant and non-dominant. Dominant side was defined as pitching arm and kicking ball limbs.

**Pitching performance measurement:** Maximal pitched ball velocity as pitching performance was measured by Radar Gun (Mizuno, Japan). From each subject a warm up was requested warm-up including stretching, throwing drills and throwing ten fastballs in bullpen to home base for data collection. Highest velocity was used as individual value.

Generally, muscle area differed between dominant and non-dominant sides. Significantly higher muscle area for the latissimus dorsi was obtained in dominant arm ( $p<0.05$ ). Significant differences of MVI values were observed in elbow extensor and latissimus dorsi muscle. Same results were obtained in vastus lateralis and planter flexor muscles ( $p<0.05$ ). Pitched ball velocity was closely related to the MVI ratio in elbow extensor ( $r=0.842$ ,  $p<0.05$ ) and latissimus dorsi muscle ( $r=0.852$ ,  $p<0.05$ ) in all subjects.

In this study, the specific muscle hypertrophy on dominant and non-dominant limbs and pitching performance were studied in baseball pitches. Significantly higher muscle area

for the latissimus dorsi was obtained in dominant arm. Significant differences between dominant and non-dominant site of MVI values were observed in each muscle. Pitched ball velocity was closely related to the MVI ratio in elbow extensor and latissimus dorsi muscles in all subjects.

#### P11Y-12

### Shoulder invertors - evertors torques production of handball players

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**Keywords:** handball, shoulder, isokinetics

The aim of our investigation was to determine the changes of the shoulder internal and external rotators produced torques in the range of movements (ROM) in the dominant and non-dominant arms of handball players.

The shoulder motions in internal - external rotation are investigated using dynamometers system "REV - 9000" Technogym. 18 male handball players participated in the investigation. All shoulder joints were uninjured. The sportsmen were seated on the "REV - 9000" bench with the elbow flexed at 90°. The humerus was abducted in the right angle to the trunk. The movements were performed in the scapular plane. The range of movements was from 20° of the shoulder eversion to 100° of the inversion. The shoulder internal - external rotation movements were tested at slow angular velocity 60°/s and fast movement 240°/s. The torques determined in the different angular positions of the ROM.

The difference between the peak torques produced by the dominant and non-dominant arms shoulders invertors and evertors are none significant at slow velocity of movement 60°/s. At high velocity 240°/s the difference between both shoulders invertors produced peak torques is significant ( $p<0.02$ ). The difference between the evertors peak torques of both arms is none significant. The shoulder invertors produced torque values are significantly higher in the middle positions of the ROM in the dominant arm at slow velocity 60°/s. At fast movements (240°/s) the invertors of the dominant shoulder exerted significantly higher torques than the muscles of non-dominant arms in the first half of the ROM of the shoulder inversion.

The shoulder evertors produced torque values do not differ in the different positions of the ROM for the dominant and non-dominant arms at slow and fast movements. Throwing activities in handball cause adaptation of the dominant arms muscles, especially shoulder invertors. The dominant arms shoulder invertors produce significantly higher peak torques than non-dominant arms muscles. The invertors of the dominant shoulder exert significantly higher torques than the invertors of non-dominant arms in the first half of the range of the shoulder inversion movement, which is more expressed at high angular velocity of movements - more specific for handball activities.



## P11Y-13

**Kinematic features identifying sport skill in air pistol athletes**

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*Keywords: air pistol, kinematics, clustering*

The aim of the study was to evaluate kinematic features of the arm-gun complex related to the skill ability of air pistol athletes.

Thirteen shooters divided in group A (more skilled) and group B (less skilled) participated. The recording session was performed at the rifle range of Rovereto. Reflective markers were attached on the tip of the gun, on the wrist, on the elbow, on the shoulder and on the neck of the subjects. Motion data was collected by an optoelectronic motion capture system (MCU240 Pro-Reflex Qualysis). The subjects were asked to keep the aiming posture for 20 seconds and then to shoot. Fifteen trials for each subject have been collected. Displacements series across time of each marker was considered in the lateral and in the vertical axis. The aiming motion was considered as formed by two different component slow drift movement and high frequency tremor. Two kinematic parameters, ROM (Range Of Movement) and SD (Standard Deviation) were calculated on slow drift motion and tremor data respectively. In order to assess the anatomical marks and the parameters, considered as our features, which best fit the skill an unsupervised cluster analysis was applied.

Percentage of wrong classification of clustering process (E% = classification error) was reported.

Best results are obtained for gun, wrist and elbow data together that show an E%=22.5% in SDz feature component, while lower performance is seen for the others features (SDy: E%=32.3%, ROMy: E%=34.3%, ROMz: E%=44.6%). The effectiveness of SD in discriminating the two groups suggests that high frequency movements are more linked to the shooting ability. Lower values of SD for more skilled athletes indicate that the ability in reducing this component leads to an improvement in performance. Conversely, as ROM feature are not effective on clustering we can argue that slow fluctuations have no effects on performance.

## P11Y-14

**Trigger release as function of the heart cycle in precision shooting**

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*Keywords: shooting, trigger release, heart cycle*

In precision shooting the trigger should be released with a minimal movement of the gun. It has been theorized that the trigger should be released late in the heart cycle, in the diastole. The rationale behind the theory was that the pulse wave during the systole would give a substantial movement of the gun. Indeed, marksmen were even trained to pull during the diastole with feedback techniques. It is true that shooters notice the pulse wave, however, it is nearly impossible to subjectively judge the impact on the performance. Our studies have revealed a more complicated pattern.

Experiments were performed on 5 air rifle shooters. The aiming procedure was monitored by pointing a laser mounted on the rifle to an x-y position device. The ordinary trigger was

replaced by a trigger which was provided with a sensitive strain gauge to record the trigger force. All signals were connected to an AD-converter, sampled at 500 Hz. The trigger force, horizontal and vertical aiming and ECG was recorded. The trigger was pulled smoothly to the braking point. The release time was calculated as the percentage into the ECG R-R interval.

The reaction from the pulse wave gave not a simple movement, rather a two or three humped wave. This was demonstrated in the vertical movement of the gun. The pattern recorded was repeated practically in every shot for the shooter whose results are depicted. For the other shooters the pattern may deviate from the one shown, however, there was never a simple movement that would resemble the typical arterial pulse wave. The trigger release was recorded for about 30 consecutive shots for all shooters during 2 separate tests, and generally no general pattern was seen, it was more like a random pattern. There is no evidence for a deliberate release in the diastole. There may be a dominance of shots released near the QRS complex. The reason could be a mechanical coupling between the pulse wave and the force applied at the trigger.

Our results clearly show that the arterial pulse wave causes a fairly complicated movement of the rifle. From a mechanical view, there should be no reason to pull the trigger at any defined time during the heart cycle. Our results give no evidence for a trigger release late in the heart cycle, rather a tendency for a trigger release close to the QRS complex. From our experiments there seems to be no good reason for the shooters to pull the trigger at any defined point of the heart cycle.

## P11Y-15

**Biomechanical effects of force application to unstable external objects**

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*Keywords: unstable external object, negative feedback loop*

Unstable conditions of force transmission absorb a significant percentage of a person's potential strength. The aim of this work was to answer the question why forces applied with the hand under static conditions to unstable objects are significantly lower than those applied to stable ones.

12 students aged 23 years participated in two experiments. First experiment: the task of the subjects was to apply maximal force to an unstable object at the natural mobility of the wrist joint. Second experiment: the subject had their wrists stiffened by plaster cast during force application. The following quantities were recorded during the measurements: force applied to the stable object  $F_0(t)$  and to the unstable one  $F_1(t)$ , and the deflection angle of the unstable object  $\phi(t)$ . Besides, the average deflection angle of the unstable object, the vibration frequency  $f$ , as well as instantaneous values of the deflection angle  $\Delta\phi$  and corresponding drops of the muscular force  $\Delta F_1$  were measured.

In the first experiment the average values ( $\pm$ SD) of  $F_0$ max,  $F_1$ max, %  $\Delta F$ , mean  $\phi$  and  $f$  were  $498.4 \pm 91.8$  N,  $375.8 \pm 58.2$  N,  $24.6 \pm 11.0$  %,  $4.5 \pm 1.9$  deg and  $5.2 \pm 0.8$  Hz. In the second experiment they became  $452.9 \pm 76.3$  N,  $444.3 \pm 57.3$  N,  $1.9$  %,  $1.6 \pm 0.6$  deg and  $4.3 \pm 1.4$  Hz. Artificial stiffening of the wrist joint replaced its natural anatomical constraints and consequently muscle force drops caused by instability of the external object were negligibly small.

In the proposed model, initially, muscles deltoid and triceps fulfil the condition, that error signal  $E_s=0$ , and are thus influenced only by stimulating signals. On loss of equilibrium

flexors or extensors of the wrist get stretched and send kinaesthetic signals to cerebellum causing Es is not 0. Inhibiting signals I are then sent to deltoid and triceps, which makes it possible for flexors or extensors of the wrist to temporarily restore equilibrium before it is lost again and the whole process repeats itself in an oscillatory fashion. Conclusions: 1 the drops of muscular force are caused by the specific control in the neuromuscular system, and not by merely mechanical decomposition of the resultant force, 2 stiffening of the wrist joint without impairing its anatomical function will help prevent dislocations and overload fractures of os lunatum and os scaphoideum due to, e.g. vibrations acting on workers using drills or pneumatic hammers.

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#### P11Y-16

### Acute effects of whole body vibration on maximal isometric strength in elite weight-lifters

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*Keywords: weightlifting, isometrics, vibration*

The purpose of this study was to investigate the acute effects of whole body vibration on maximal isometric strength.

10 elite weight-lifters (2 females and 8 males) volunteered for the study (age=24, SD=2.6; body weight=78kg, SD=15; height=1.65m, SD=34.79; personal best in clean & jerk=161.5, SD=40; snatch=131.45, SD=34.79). Subjects were tested on maximal isometric strength in three different positions of the clean & jerk in the following sequence: 1. at the beginning of the lift, when the barbell is still on the ground, 2. when the barbell is at the hips, 3. when the barbell is on the shoulders. These isometric actions were performed against fixed barbell.

Subjects performed two trials with slow velocity and two trials by trying to reach maximal force as fast as possible in each position. Maximal isometric force and rate of tension development were recorded by using a force plate. After the tests a whole body vibration was applied (10x1minute with 1minute rest, at 30Hz). 10 minutes later the strength tests were repeated in the same sequence.

Maximal isometric force in the 1st condition decreased significantly (4.1%), and did not change in the 2nd condition; however, it increased significantly in the 3. condition (6.2%) after vibration. Rate of tension development did not change significantly in any of the conditions after vibration.

From the results can be concluded that whole body vibration increased performance only in the 3rd condition, when the barbell was on the shoulders and was ready for the jerk. Since conditions were not randomized among subjects we

can only assume that in the 1st condition vibration had a fatiguing effect, which decreased by the 2nd condition, and disappeared by the 3rd condition.

#### P11Y-17

### Analysis of motion and patterns of play of elite men's water polo

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*Keywords: water polo, analysis of motion, patterns of play*

Over the last decade there have been few published studies in the field of water polo. The aim of this study was to analyse 4 different aspects of water polo.

1. The various movement types incorporated by elite international water polo players with regards to distance travelled and duration.

2. Analysis of passing patterns and their outcomes. Specific attention was paid to the connection between length of passing sequence or possession and goal scored.

3. Different attacking structures adopted by teams in the final third of the pool during "even" and "man-up" situations.

4. To establish the styles of play adopted by the goalkeeper to defend against attacking play.

A hand notation system was designed to measure the duration of an action and the intensity of movement in order to find overall and average distances travelled. ANOVA and Tukey's HSD post-hoc test revealed that significant differences ( $p < 0.05$ ) were found between playing position and overall distance swam using front crawl, overall distances travelled at low level intensity, average eggbeater duration, and average ball possession duration.

The second system was designed to analyse passing patterns of five international teams. Comparisons were made using a Mann-Whitney Confidence Interval test at a level of 95% and a Kruskal-Wallis test, these analyses revealed significant differences ( $p < 0.05$ ) between: 'short' possessions, 'long' possessions, goals from 'short' possessions and goals from 'long' possessions. A total of seven international water polo games were analysed using the third system, post-event. Significant differences ( $p < 0.05$ ) were found in the types of attacking structures used during 'even' and 'man-up' plays. Furthermore, there were significant differences ( $p < 0.05$ ) between the number of 'short' and 'long' possessions and the total number of 'short' and 'long' possessions preceding a shot or goal. Finally, eight international water polo games were analysed in order to create a profile on the play adopted by goalkeepers at this level of ability. Significant differences ( $P < 0.05$ ) were found in the distribution of shots, direction of shots, position of the goalkeeper and the success rate of goals and saves with respect to the body position of the goalkeeper.

## Poster Session

## Biomechanics 4

P11Z

P11Z-01

**Modifications in head and neck posture during induced oral breathing****Turci Michela, Grassi GianPiero, Colombo Anna, Shirai Yuri, Sforza Chiarella**

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*Keywords: neck posture, head posture, oral breathing*

Oral breathing is induced in several sports (swimming, synchronized swimming, skin and scuba diving), and physical activities (snorkeling). The influence of induced oral breathing on head and craniocervical posture was studied in 10 young adults.

Five men and five women volunteered in the study (age 23±2). They were healthy and free from nasal allergies, chronic respiratory infections, and history of mouth breathing. After a baseline recording, oral respiration was induced by using a swimmer's type of nose clip. On each subject, nasion (midline of the nasal root and nasofrontal suture), tragon (notch on the upper margin of the ear tragus), and spinous process of the seventh cervical vertebra (C7) were identified. The subjects were filmed in standardized conditions. The TV camera was mounted on a tripod, leveled with the optical axis of the lens horizontally (Ferrario et al., 1995). The subjects stood in a comfortable stance chosen by themselves with both arms hanging freely beside the trunk, corresponding to a "natural head and body posture". Those with corrected vision wore their prescription lenses. The subjects were filmed 15 and 90 minutes after wearing the nose clip, immediately and 15 minutes after taking it off. For each subject, the angles C7-tragon vs. the true vertical, nasion-tragon vs. the vertical, C7-tragon-nasion were calculated from the films, and the difference between the baseline and the four experimental recordings was computed.

During the experiment, head and neck positions modified in all subjects, but with a large variability for both the direction (flexion or extension) and the extent of the modification. Overall, the mean differences were minimal, with large standard deviations. Differences between baseline and the experimental recordings were significant only for the C7-tragon vs. the vertical angle: 0.83° (±0.58) after 15 min with the nose clip on, 1.31° (±0.76) after 90 min, 1.09° (±0.86) immediately after taking the nose clip off, and 0.1° (±0.89) 15 min later (ANOVA,  $p = 0.008$ ).

In conclusion, induced oral respiration may have a significant role in the alteration of head and craniocervical posture, but the effect was highly variable. Further investigations should be extended to larger groups of participants.

*Ferrario VF et al (1995). Cranio-J Craniomandib. Pract. 13: 247-255*

P11Z-02

**Time-variant spectral analysis of surface electromyogram in maximal and explosive voluntary isometric contraction****Heller Mario, Edelmann-Nusser Juergen, Witte Kerstin**

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*Keywords: EMG, frequency-time analysis, explosive power*

Generally it is assumed that explosive power depends on many factors such as hypertrophy, muscle fibre composition, recruitment and rate coding organisation in motor-unit pools. Surface electromyography (EMG) represents neural stimulation of skeletal muscles. Most of EMG spectral analyses base on Fourier transforms. But owing to the non-stationary behaviour of real biological signals this method may not always be appropriate since Fourier transforms require stationary signals. A new method to do frequency-time analyses of non-stationary biological signals is the time-variant spectral analysis. The purpose of this study is to investigate time-variant characteristics of spectral analysis of surface electromyogram in maximal and explosive isometric voluntary contraction (MEVC) using the time-variant spectral analysis.

Thirteen male and six female students of sports science took part in a six week period of strength training doing bench throws three times a week with various volumes and intensities. Four tests were done for each subject (pre, between 3rd and 4th week, post and two weeks after training was finished). In the tests the subjects were required to perform maximal and maximal explosive voluntary isometric contraction (elbow angle and shoulder-trunk-angle about 90°) three times with a 1 min pause in between.

EMG signals of the m. triceps brachii and the m. pectoralis major were acquired (bipolar surface electrodes) according to standard method (sampling rate 1kHz) and analysed using the time-variant spectral analysis: Median frequency, time course of frequency band and mean power were calculated. The gradient and the maximum of the force were calculated. The mean values of MVC (6%) and MEVC (31%) increased significantly ( $p < 0.01$ ).

For most subjects the time course of the median frequency can be described at least for one of both muscles as follows: The median frequency starts to increase from a low level shortly before the force starts to increase and reaches its maximum value shortly before the gradient of force reaches its maximum value.

A similar behaviour was found for the mean power.

P11Z-03

**Redistribution of load under the child's foot while walking shod and with different insoles compared to barefoot****Müller Steffen, Baur Heiner, Ewald Annette, Hirschmüller Anja, Mayer Frank**

Medical Clinic, University of Freiburg, Germany

*Keywords: gait, children, loads*

Lower injury rates are described while walking barefoot. The main function of shoes is the protection from injury and

infection, and if possible the maintenance of a natural movement pattern. Purpose of the study is the identification of load redistribution under the child's foot walking shod compared to barefoot. In a second step, possibilities to modify load distribution were examined with different insoles. 56 healthy children (age:  $7.5 \pm 1.5$  years) were analysed walking on a treadmill (3.5 km/h). 5 conditions were measured in random order (barefoot [a], original children shoe [b], shoe with neutral flexible sports insole [d], shoe with rigid leather insole with longitudinal wedge and brace [e], shoe with flexible sports insole with longitudinal and detorsion wedge [g]). Plantar pressure distribution was measured with the pedar mobile system. Force time integral was analysed in 10 regions of the foot (1/2 med/lat rearfoot, 3/4 med/lat midfoot, 5-7 med-lat forefoot, 8-10 toes med-lat) for each subject and condition. First the values were normalized to the total load of the foot and second the change of load [d], compared to barefoot was calculated [in %]. Analysis was made descriptively with mean  $\pm$ SD. Comparison shod/barefoot: Low changes in region 1, 2, 6 and 7 ( $\pm 3-15$  %). In region 3 (medial midfoot) and 8 (big toe) highest changes of d with +1217 % and +1435 % occurred. In area 4, 5, 9 and 10 d changes between +71 and +282 %. Comparison insoles/barefoot: The insole d, e and g produced main changes in region 3 (d: +2325 % d, +5706 % e and +5542 % g). The other regions showed lower changes. Mean Standard deviation was 7 times the amount of d. Walking with shoes and insoles, causes differences in load distribution and did not allow a loading like barefoot. Especially in region 3 a high influence (d: between +1217 % and +5706 %) under all conditions was found. Insoles produced further changes, but not to a more natural barefoot pattern. In most regions of the foot changes are small and unsystematic with high standard deviation. Nevertheless the biological relevance should not be neglected, especially in the medial midfoot area. The influence of different surfaces on the natural movement pattern is still to discuss.

#### P11Z-04

### Distinguishing motor unit activity using wavelet analysis of surface EMG

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**Keywords:** EMG, frequency, fibre type

Recent investigations have identified bursts of muscle activity that are distinct in both time and frequency and repeatable within a cycle of movement for both running (5) and cycling (4). One explanation provided for these observations is that the different frequency bands of EMG may represent activity from different motor unit types. Previous research indicates that an increase in mean frequency of EMG power spectrum accompanies an increase in isometric force (3), likely due to faster motor unit recruitment (1,3). The purpose is to investigate the relationship between EMG activity at different frequencies and the graded motor unit recruitment patterns which occur during increasing isometric contractions of the quadriceps.

Surface EMG was measured from the vastus lateralis, rectus femoris and vastus medialis muscles. Subjects were required to perform a series of ramped isometric contractions from zero to maximum force. EMG signals were resolved into their intensity in time-frequency space using wavelet techniques (4). Peaks in EMG intensity were identified in each frequency band if they exceeded 1% of the maximum signal intensity. Peaks in the higher frequency bands first occurred at greater muscle forces during the ramped contraction than those at

lower frequencies. The intensity spectra showed that 99% of the signal intensity and 93% of the recorded spikes occurred below 330Hz. The frequency bands previously identified during running (5) showed initial activity at the different force levels of 8% and 49% MVC, respectively during the ramped contractions. An ANOVA showed that these force levels were significantly different ( $p < 0.001$ ). It was expected that the motor units were recruited in an orderly fashion during these isometric contractions (2).

Results indicate that the peaks in EMG intensity the higher frequency bands result from the action of the faster motor units. These observations support previous suggestions (5) that the myoelectric activity occurring at different frequency bands and different times within a running stride may result from the action of different types of motor unit.

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#### P11Z-05

### Determination of individual muscle properties and simulation of simple movements

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**Keywords**

It is possible to describe the connection between the properties of an athlete and the sports movement with mathematical models. The following should describe the possibilities of a model that allows to determine muscle properties of a subject and to simulate simple movements individually.

In squat jumping the force developed by the muscles accelerates the mass of the subject upwards. The mathematical description of this movement (Sust, 1996) uses the Hill equation for the force in the muscle, an activation function  $S(t)$  to describe the innervation of the muscle and a geometric function  $G(X)$  which represents the connection between internal and external force. Together with Newton's law we have a nonlinear differential equation which can be solved numerically.

For the calculation of a squat jump performed by a subject one needs the parameters for the differential equation. These are the subject properties (like mass, muscle properties (maximal isometric force "fmax", maximal possible velocity "vmax" and power "pmax") for the Hill equation, properties of activation and anthropometric data) and the movement conditions like the gravitation and the height of starting position. Changes of the input data relate on one hand to the movement conditions and on the other hand to properties of the system (= human). Both lead to variations in the movement, in particular to other take off velocities and jumping heights.

A measurement system at the Institute of Sport Sciences Graz allows to determine the individual muscle properties of the leg extensors with a few measurements by using nonlinear parameter estimation. Simulations with the received properties show the effects of the nonlinear connection between the properties and the sport performance. The same relative changes of muscle properties for different subjects show strongly different changes of jumping heights. It has been shown, that eg. the same increase of the activation parameter "A" leads to an increase of jumping height for subject I but to a decrease for subject II.

Simulations have confirmed the assumption that the improvement of one muscle property leads to individual changes of the movement performance. This is a further argument for the individualization of training in high performance sports. Parameter estimation and simulation allow to receive the performance determining properties for an athlete individually.

#### P11Z-06

### Visualisation of selected technical aspects in elite triple jumpers

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**Keywords:** kinematic analysis, triple jump, visualisation techniques

Triple jump (TJ) includes the specificity of complex abilities, particularly jumping rhythm and management, good take-off coordination into hop (H), step (S) and jump (J) as well as balance during jumping flight. Quoted TJ performance limited characteristics: low horizontal velocity ( $v_{horiz}$ ) deficits during take-off phases (t-oP), improvement of jump-distance relation of H & S concerning duration, jump-height,  $v_{horiz}$  and percentage optimisation of the phase distances (PD) (H: ~36%, S: ~31%, J: ~34%). The aim of our project is to observe the above mentioned movement characteristics in elite nat. & int. TJ both sexes (m; f). Beyond kinematic data collection we compile a routine visualisation system of selected technical aspects.

We analysed 522 TJ (German (DM) & European Championships (EM) 2002) of 46 m and 35 f TJ, registered by a digital video camera (DV) and laser velocity measurement system (Laveg; 100Hz). DV has been placed perpendicular to H-S transition to capture the side movement; markers placed each meter between 5 m prior to board and landing pit to calculate PD; 2D-kinematic analysis (DartTrainer; AdGraph). Laveg was placed in jumping direction to measure distance between laser detector and reflecting object; directed on lower back to register instant speed. TJ-movement were visualised by StroMotion. Technology includes image line in one picture, i.e. breaks down a mov. object into frame-by-frame sequence to highlight position & trajectory. Videos were combined with synchronised velocity curves. Both techniques gave excellent multiplex information.

Results of finalist DM vs. EM: av. TJ performance: delta-7-8%; av. max. velocity ( $v_{max}$ ) in run-up: delta-3-4%; %-PD-relation of DM (EM): 36.6(37.3)H, 28.4(27.5)S, 35.0(35.2)J (f) & 36.9(37.4)H, 29.9(29.5)S, 33.3(33.0)J (m); elite TJ's; peak  $v_{max}$ : 10.6 m/s; PD of H & J: each >6m; sig. coherences of  $v_{max}$  resp.  $v_{transition}$  H and effective (official + toe-to-board) distance in m & f ( $p < 0.05$ ).

In summary we found nat. H-dominated jumps in contrast to more J-dominated or balanced (bal.) techniques in elite TJ (>17.4m (m); >14.5m (f)). High run-up velocity ( $v_{run}$ ), paired with short contact times and more bal. jump technique or lower peak  $v_{run}$ , combined with lower jump-height and bal. jump technique leads to big overall distances. An elevated reduction of  $v_{horiz}$  can be influenced due to large H, translational & rotational instabilities of upper body and above-av. deflections of knee & hip during the H-S- & S-J-transition. Fukashiro S et al (1981). *Med Sci Sports Exerc* 13: 233-237 Fukashiro S, Miyashita M (1983). *Med Sci Sports Exerc* 15: 309-312

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#### P11Z-07

### Individual influence of additional mass on time course characteristics of ground reaction forces in human gait

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**Keywords:** gait analysis, pattern recognition, ground reaction force

Human gait has been investigated extensively during the last decades. Parameters like gender, speed, age or disabilities were studied as well as time discrete biomechanical parameters. Aim of this study was the investigation of the influence of additional mass on individual gait patterns.

Therefore 2 male and 2 female subjects were asked to walk over a Kistler force plate (1000 fps) with their comfortable speed carrying an external load of 0%, 20% and 30% of their body mass (bm) in a special vest and a backpack. 3 steps left and right were obtained in each case. All data were normalised by the specific mass (body mass plus n%) so only the qualitative gait characteristics remained. For each subject a distance matrix for all steps was evaluated before and after the normalisation. The distance matrices for each subject were analysed with a hierarchical cluster analysis.

The results show a coarse separation of the ground reaction force patterns by the external load before the normalisation at three subjects. After normalisation a separation was found again at three different subjects. A clear clustering of the different loads was only achieved by the female subjects. A male subject displays a separate cluster only for +30% bm. The other ground reaction force patterns were clustered by left and right foot. Similar results were found by the second male subject where three clusters were separated, two for the right steps and one for the left steps. Within these clusters the different loads were mixed.

In conclusion mass has an influence not only on the quantitative but also on the qualitative characteristics of gait patterns. Evidence for a critical mass is given at which the gait patterns change their individual characteristics. However, this threshold seems to be individual.

#### P11Z-08

### Normalised force during isometric, concentric and eccentric contractions in young and older women

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**Keywords:** muscle force, contraction types, aging

The purpose of the present study was to examine the effect of age on normalised knee extension force during isometric, concentric and eccentric contractions.

Eight young women (YW; 25.0±4.0 years) and eight older women (OW; 67±6.6) were assessed for lean muscle cross-sectional area of the m. quadriceps femoris (LQCSA) using magnetic resonance at mid-thigh level. A series of maximal voluntary contractions were performed using a Kin-Com isokinetic dynamometer under ISO conditions at 65° knee flexion, and CON and ECC conditions at 60°/s through a range of 15-80° (reference 0° being full extension). The single highest peak force value was determined for

contraction type and normalised force was calculated for each muscle action as peak force per unit-area of muscle.

No significant difference in thigh circumference or total cross-sectional area was observed between age groups. Total muscle compartment area and LQCSA of the quadriceps was significantly greater for YW (70±8cm<sup>2</sup> and 63±8cm<sup>2</sup>, respectively) compared with OW (54±6cm<sup>2</sup> and 44±5cm<sup>2</sup>, respectively) ( $p < 0.05$ ). Peak ISO, CON and ECC forces were significantly greater for YW (ISO 487±123N; CON 420±90N; ECC 542±106N) compared with OW (ISO 331±58N; CON 255±46N; ECC 420±53N) ( $p < 0.05$ ). Normalised ISO force was similar between age groups ( $p > 0.05$ ). Normalised CON force was significantly less for OW ( $p < 0.05$ ), however, during the ECC contraction normalised force was significantly greater for OW ( $p < 0.05$ ).

The present finding of similar normalised ISO force values for YW and OW is consistent with previous research findings (Kent-Braun & Ng 1999). Such results indicate that the ageing atrophy is most responsible for the age-associated reduction in peak force under ISO conditions. However, the significant reduction in normalised CON force associated with ageing suggests that; 1) the magnitude of age-associated reduction in peak force is greater during CON contractions compared with ISO efforts, and; 2) that factors other than the ageing atrophy are responsible for the age-associated reduction in peak CON force. In addition, these findings also indicate that ageing is associated with an increase in the force production capacity of muscle under ECC conditions. These are novel findings yet to be reported in the literature. We suggest that the slowing of muscle contractile properties and/or changes in muscle structure associated with ageing are the most plausible mechanisms responsible for these phenomena.

#### P11Z-09

### Importance of stretch-shortening cycle exercise in the transition phase of sprinting

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**Keywords:** *sprint, power, acceleration*

Stretch-shortening cycle (SSC) exercise is an important physical strengthening factor for improving sprint performance. Especially, the sprinting velocity during the acceleration phase directly affects the finish time. The purpose of this study was to clarify the influence of SSC exercise on sprinting ability during the acceleration phase, and to propose a concrete method to optimize sprint acceleration.

The subjects were 66 male track and field athletes (age 19.8±1.0 years; body height 173±5.2cm; body mass 66.3±10.8kg). After warming up, the subjects performed the rebound jump (RJ); they could use their arms to assist them. In this study, the maximum anaerobic power in RJ was assumed to be an evaluation index to achieve SSC exercise. Anaerobic power is calculated from the contact time and the flight time by RJ. After RJ test, the subjects ran a 40m sprint. This study used data on sprinting velocity (SV), sprinting power (SP), stride frequency (SF) and stride length (SL) at 10m intervals. SP was calculated from SV and the sprinting acceleration at every 10m section. In this study, SP was assumed to be an evaluation index of the sprinting ability during the acceleration phase. SV in the 10-20m section correlated significantly with the finish time of 40m sprint ( $p < 0.001$ ). We therefore studied the sprint performance in the 10-20m section and its relationship to rebound jump power (RJP), and found a significant correlation between

RJP and SV ( $p < 0.001$ ), SP ( $p < 0.001$ ) and SL ( $p < 0.01$ ). However, no correlation was found between RJP and SF. The findings of this study suggest that SSC exercise increased SL in the transition phase of the sprint. Therefore, the sprinter must learn how to achieve SSC exercise in sprinting. Proposal: This study proposes a method for demonstrating to achieve SSC exercise during the transition phase of sprinting. First, after the starting block phase, the following points are emphasized for steps 1 to 11: (1) the knee is not excessively extended; (2) the foot does not push strongly into the ground; (3) the ankle is fixed; (4) in the contact phase, only the ball of the foot touches the ground and (5) the contact point is put on the right under of the pit of the stomach.

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#### P11Z-10

### Objective evaluation of spastic hypertonia with a 3-dimensional motion analysis study: patients after stroke treated with botulinum A toxin

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**Keywords:** *3D analysis, botulinum, spastic hypertonia, endurance, tennis, psychosociology*

Botulinum A toxin was injected into the gastrocnemius medialis muscle and soleus muscle of three patients following stroke or brain injury. All three subjects had been already treated with common rehabilitation such as Kabat and Bobath Concept at least for three years without any significant changes.

3- dimensional motion analysis study was taken before and 14 days after application of botulinum A toxin. One subject was analysed with 3D motion study additionally after 85 days. The patients walked on the 5m long carpet and their movement was recorded by 4 miniDV videocameras. On the lower limbs there were marks on the skin, which represented the significant points on the skeleton. For the 3D coordinates of the points on the body the DLT algorithm was used.

3D analysis observed mainly flexion-extension of knee joint, forward trajectory of knee and ankle joint to show the changes in walk before and after therapy. Future research is focused on objective quantification and qualification of spastic hypertonia helped with other appliance such as myotonometer pressure distribution platform. The doses of botulinum A toxin were enormously low compared with other works and only 3 units/kg body weight were injected into the studied muscle group. No health difficulties were found and expected results were fulfilled. We decided to apply botulinum A toxin in patients who had undergone for a couple years an intensive rehabilitation without any progressive improvement and show if the application of this drug can help to decrease the spastic hypertonia. We decided to treat the whole handicapped part of the body and from this reason to use smaller dose of botulinum A toxin for the triceps surae muscle.

## P11Z-11

**The influence of stretch-shortening-cycle (SSC) on turning performance in competition swimmers****Recht Miriam, Schmidbleicher Dietmar**

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*Keywords: swimming, stretch-shortening cycle, freestyle flip turn*

The aim of this study is to provide an analysis of factors influencing freestyle flip turn and to investigate the relationship between SSC training for leg extensor muscles, training volume in water and turning performance.

12 female and 10 male competition swimmers were assigned to a group with high and a group with lower training loads in water. Both groups were tested for variables of freestyle flip turn and effects of reactive training methods. Individual physical condition of leg-extension was measured by a Standard Jumping Test consisting of squat, countermovement and drop jumps from different heights as well as leg-press (isometric contraction). In order to measure turning parameters kinematic analyses using underwater videography and kinetic analyses using an underwater force plate were implemented. Land training consisted of training twice per week for 12 weeks, divided into 4 weeks of jump exercises (drop jumps from individually optimal height, 4x12 rep. with max. intensity, 6 s of rest between jumps, 10 min between sets), 4 weeks of maximum strength training at leg press (3x3 max. contractions at explosive movement speed, 6 min of rest between sets and a second 4-week jump training. Statistical analysis based on stepwise regression, one-way ANOVA with repeated measurements and Scheffé test.

The results indicate that short wall contact times as well as increased push-off velocities produced the fastest 5m turn time. Shortest wall contact times seem to depend mainly on an optimal knee angle during push-off. The results of the training experiment show a small efficiency of SSC training in competitive swimming. First of all swimmers with higher training loads in water (> 120km/month) did not improve their jump abilities after the intervention phase. The swimmers who better their jump abilities realized shorter wall contact times, but this did not result in an increased impulse production at the wall and faster wall exit velocities as a result of SSC. One can speculate that elastic potentiation of muscle and reflex activation do not influence turning performance in this group of swimmers, because of small knee angles during push-off ( $70,07 \pm 11,48^\circ$ ) and thus too long contact phases ( $337,94 \pm 65,58$  ms).

## P11Z-12

**A feedback system for rowing****Kornfeind Philipp, Baca Arnold, Tutz Martin**

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*Keywords: rowing, feedback system, ergometer*

Biomechanical analysis in rowing involves the consideration of the kinematics and kinetics of the boat-rower system. Different authors identify the curve shapes of the horizontal and vertical acceleration of the rower's center of mass w.r.t. the boat and the curve shape of the force applied to the oars as important factors for a good rowing technique. Fluctuations of the boat velocity due to the forward/backward motions of the rower should be kept low, vertical motions of the center of mass of the rower are ineffective from an energetical point of view, the shape of the force applied to

the oars should be bell-shaped. A feedback system on the basis of these criteria is under development. This system allows visual feedback in real time. In addition, a video may be produced which allows to study deficiencies after the rowing action. Different feedback systems have already been developed as an aid to improve rowing technique. The system presented is based on a rowing ergometer and force plate measurements. It is supposed that results obtained from analysing ergometer rowing give good indications for on-water rowing.

A measuring station has been constructed. A rowing ergometer (Concept II) is placed onto two force plates. Vertical ground reaction forces are measured from both force plates, horizontal forces (in motion direction) from the back force plate (floating bearing at the front force plate). An incremental encoder is used to measure the position of the sliding seat. A force transducer has been connected to the chain attached at the handle and generates a signal proportional to the athlete's pulling force. Horizontal and vertical ground reaction forces, the pulling force and the position of the slide are recorded simultaneously and may be displayed in real time on a monitor in view of the rower. The time histories of all these data are stored on disk and may be superimposed to a video sequence of the rower on the ergometer afterwards. The curve shapes of the horizontal ground reaction forces show much more inter- and intraindividual differences than those representing the pulling forces. We expect that valuable information can be derived from the first.

The system developed can provide feedback on parameters significant for a good rowing technique. Further research must be undertaken to vividly visualize technical deficits derived from these parameters and to prove the effectiveness of this particular feedback method compared to other feedback methods.

## P11Z-13

**Wavelet analysis can be used for evaluating correlation between vastus lateralis and vastus medialis for patients with patellofemoral pain syndrome****Toyoda Yukiko, Nigg Benno, Wakeling James, Wiley Preston, Humble Neil**

Human Performance Lab, University of Calgary, Canada

*Keywords: EMG, wavelet analysis, patellofemoral pain syndrome*

Patellofemoral pain syndrome (PFPS) has been the most common overuse injury in runners. One of the proposed factors is imbalances between vastus lateralis (VL) and vastus medialis oblique (VMO) muscle activity and many studies have used electromyography (EMG) to investigate the relation between the muscles. However, the relation in muscle activity pattern between these muscles is not well understood (Thomee et al. 1999). Recent development of wavelet technique enables to resolve EMG signal into time-frequency space, which show more detail about muscle activity (von Tscharner, 2000). Therefore, the purpose of this study was to apply this new EMG analysis technique to PFPS runners in order to compare the frequency dependence of co-contraction between VL and VMO during running.

The runners with PFPS participated in the study and EMG (2000Hz) from VL and VMO was measured during 30 minutes runs twice a week for 6 weeks. EMG signal was resolved into 10 frequency bands (centre frequencies ranging from 19.3 to 395.5 Hz) using wavelet technique. Total intensity (sum of all the frequency bands) is equivalent to

twice of RMS value, therefore, comparison of techniques was made between intensity at high- and low frequency and total intensity. Pearson's correlation coefficient for each frequency band was calculated between VL and VMO intensity as a measure of synchrony.

The results showed distinct differences in muscle activity pattern between total intensity and each frequency band. Correlation coefficients between VL and VMO also showed differences at different frequency bands. The different frequency components represent activity from different motor units (Rozitis and Wakeling, 2003). Therefore, it is speculated that studying muscle activity between VL and VMO at different frequency components may be important. Those differences can not be quantified using traditional techniques which only show EMG property in either time or frequency space. Using wavelet analysis provides both time and frequency information of muscle activity in VL and VMO. Therefore, this new technique will help us to understand the causative factors of PFPS and provide useful insight in treatment.

Thomee R et al. (1999). *Patellofemoral Pain Syndrome. A clinical review. Sports Med.* 4: 245-262

Von Tscharnar (2000). *J. Electromyogr. Kinesiol.* 10: 433-445

Rozitis and Wakeling (2003) *ECSS abstract*

#### P11Z-14

### **EMG activity of leg muscles at different levels of mechanical power produced on a cycle ergometer**

**Pietraszewski Bogdan, Siemienski Adam**

Academy of Physical Education and Sport, Poland

**Keywords:** *EMG, mechanical power, cycle ergometer*

Surface electromyography is commonly used to assess muscle activity in a variety of motor tasks. However, the specific question of the relationship between the amplitude of the EMG signal and the force generated by a muscle is still open, especially under dynamical conditions. Hence the aim of this study was to find out how the level of electric activity of the main leg muscles depends on the external mechanical power produced during pedalling on a cycle ergometer.

Eighteen students volunteered to be subjects in this investigation. Their average age, body mass and body height were, respectively, 20.6 years, 75.4 kg and 181.5 cm. The subjects were asked to cycle for 10 minutes on a cycle ergometer at a constant cadence of 70 r.p.m. The 3 sessions of the experiment, separated by one-week-long intervals, included cycling at 3 different loads resulting in mechanical power equal to 100 W, 200 W and 300 W. EMG signals were collected from four leg muscles: vastus lateralis, vastus medialis, biceps femoris and gastrocnemius using an eight channel EMG device. A single measurement lasted eight seconds and comprised on average nine leg thrusts. Such measurements were carried out every 3 minutes during each ten-minute-long trial, and one additional measurement was carried out during a short period of pedalling at the same power level and at the same cadence but after a 3 minutes rest following the ten minutes trial. The EMG signals were amplified 500 times, sampled at 1000 Hz, and processed by calculating RMS in a moving window whose length corresponded to the average duration of one leg thrust. The maxima - one per thrust - of the processed signal yielded thus a RMS value for each thrust.

Results exhibit monotone dependence of EMG amplitudes upon external power for all the muscles considered. Fatigue progression can also be seen, which manifests itself in

enhanced electric activity required to maintain the prescribed power level towards the end of the trials.

Because of the constant cadence the increases in external power output were solely due to the increasing forces produced by the leg muscles.

These allows to draw conclusions as to the shape of the relationship between EMG amplitude and muscle force at a given contraction velocity, which appears to be consistently monotone and nonlinear (downward convex).

#### P11Z-15

### **The finite element method used to study stresses of the acromio-clavicular human joint**

**Didu Sorin, Tarnita Dan, Tarnita Daniela, Grecu Dan**

Emergency Hospital, Romania

**Keywords:** *stress, finite element method, acromio-clavicular joint*

In order to three-dimensionally reconstruct the acromio-clavicular joint we used the section method and we divided the bone extremities as well as the entire joint into 14 sections by using the computer tomograph. We built the spatial model using the Solid Works program. Then we used the ANSYS program for the three-dimensional reconstruction. The spatial model was realized by using the tetraedrical finite elements. The acromio-clavicular joint was compressed by a force acting on postero-anterior direction.

We obtained the three-dimensional reconstruction of this structure highly resembling the original by using the finite element method and the tomograph computer. Finally, we obtained the equivalent Von Mises stress distribution for the static solicitation on postero-anterior direction of the acromio-clavicular joint.

By analyzing the tension diagrams we realized that the most solicited part of the acromio-clavicular joint is the lateral clavicle extremity. The observations made by studying 45 cases with shoulder traumas caused by the compression solicitations showed that either the lateral extremity of the clavicle was fractured or the acromio-clavicular joint was sprained. This confirms the final observation to which we got to by simulation.

#### P11Z-16

### **The effects of the manipulation of vestibular system on the center of mass deviation in adolescent idiopathic scoliosis**

**Ghazaleh Leila, Farahpour Nader, Allard Paul**

Bu Ali Sina University, Iran

**Keywords:** *dynamic balance*

Neuromuscular system is one of the major body systems, which is affected in scoliosis. Dynamic balance of patients with idiopathic scoliosis has not been reported before. The objective of this study was to compare the dynamic balance of untreated idiopathic scoliotic patients with normal subjects. Ten adolescents with idiopathic scoliosis between 11 to 17 years old and 13 healthy age matched subjects were participated in this study. Using dynamic stability platform, the dynamic balance of subjects in different positions, including up right standing, standing with head flexion and standing with head hyper extension was evaluated. The tests were repeated in both stable and instable condition of the foot platform lasting 20 second for each test. The balance indices



were given as the deviation of the center of foot pressure in total, anterior-posterior (AP) and medio-lateral (ML) directions.

The deviation of COG from COBOS in total and AP was greater than that of the ML direction in all groups. Dynamic balance of scoliotic patients was similar to that of the normal. This was similar to findings of Yekutile (1981) and against conclusion of Dinner (1984) who reported a balance disorder in scoliosis (1,2). There was not any significant difference between groups on all variables. The head flexion or hyper extension resulted in an increased deviation of the COG by 2.5 times in control and patients. Hyper extension had a greater influence than that of the flexed position of the head in both groups.

Dynamic balance in scoliosis was not affected. Vestibular disturbance did not explore any abnormality in patients. A more complex study on dynamic balance of scoliotic patients before and after treatment is necessary for better understanding.

## Symposium

### Analysis of Sport Related Factors of Performance (interdisciplinary strategies)

S113A

## S113A-1

#### Analysis of sport related factors of performance

Krug Juergen

University of Leipzig, Germany

Keywords: *training theory, interdisciplinarity, elite sport*

In this paper sport related factors will be analyzed on the example of elite sport. In recent years elite sport was increasingly separated from other fields. At this high level of performance there are many topics for investigations and scientific advice for training. The focus in this paper is a training-theoretical approach. Further areas of consideration for this paper are psychological, biomechanical, and physiological approaches.

Most studies in high performance sport are disciplinary investigations. However, the complex character of elite sport requires interdisciplinary investigations. This demand should be developed in this paper. Interdisciplinarity is characterized by systematic cooperation of different disciplines and target adequacy of common theories and methods. The type of research engaged in elite sport concerns a practice-oriented understanding of science.

In recent years performance in most kinds and disciplines of a high performance competitive sport has increased. Using state-of-the-art analyses as a systematic characteristic mode of working, it seems that the increase of performance will continue. For example, in swimming some biomechanical aspects show that the level of performance is improving (Blackwell & Sanders, 2001). Physiological analyses of current training load prove that the health risks and overloading risks were also increased (Steinacker & Lehmann, 2002). Personality and performance development among elite athletes is an important psychological view (Breivik, 1999). Though, in the last years the problem of doping puts pressure on the elite sport (Peters, Schulz & Michna, 2001; Breivik, 2001). Interdisciplinary strategies give better reasons for training rules.

Interdisciplinary strategy should involve substantial demands on research of training and competition in elite sport.

Using more teamwork of scientific disciplines the foundation of the training theory could be on a higher level.

Steinacker JM, M Lehmann (2002) *Enhancing Recovery: Preventing Underperformance in Athletes*. 103 - 118

Breivik G, (1999) *Science in elite sport*, 146-162

Breivik G, (2001) *Doping Games in Elite Sports*

Blackwell, J, Sanders, R (2001) *Proceedings of Swim Session, ISBS*

## S113A-2

#### A physiology approach - new aspects of training in rowing - from physiology to psychoendocrinology

Steinacker Jürgen, Lormes Werner, Stilgenbauer Franziska, Liu Yuefei

Department of Medicine II, University of Ulm, Germany

Keywords: *muscle, mood state, hypothalamus*

Rowing is a sport with high training load and high metabolic demands and can be used as a model for the training response.

Supercompensation cycles can lead to exhaustion and fatigue in the high load training periods and elicit corresponding cellular stresses and consecutively should raise performance in the recovery periods as an adaptation to the training overload.

The peripheral cytokines and hormones leptin, insulin, cortisol, IL-6 and insulin-like growth-factor I (IGF-I) profound effects not only local but also on the hypothalamus by specific receptors on excitatory neurons. The hypothalamus which integrates various error signals (metabolic, hormonal, signals from afferents, and central stimuli).

The links between the peripheral metabolic and hormonal reactions, hypothalamic-pituitary axes and mood state seem to be important (yet have to be examined more detailed) which means that physiology and psychoendocrinology seem to be closely connected.

## S113A-3

#### Background, personality and performance development among elite athletes

Breivik Gunnar

Norwegian University of Physical Education and Sport, Norway

Keywords: *personality, social background, athletic development*

Studies of elite sport often focus on narrow physiological or psychological factors. Few studies look deeper into the social background, personality characteristics and career development and try to get a more comprehensive grip on the total development of the athletic career from childhood unto adult elite level.

Three studies are presented in this paper. The first one focused on childhood, adolescence and elite career development of the 18 most successful Norwegian athletes in individual sports in the 1990s. A matched group of the next best was used as comparison. The very best were very active as children, had strong backing from a stable family, the specialization into one main sport came later and the success came very gradual. Early specialization does not seem to be linked to having a successful career. A second study linked genetically based personally characteristics to choice of sport type.

The results showed that "sensation seeking" was an important moderator variable that explained choice of sport, position inside a team and behavioral characteristics. This

means that interested and talented children should be channeled into a type of sport where they may feel happy and may excel. A third study of 88 Norwegian Olympic athletes found that work and economic situation influenced career and training. The athletes in many cases had to choose between being poor and have time to training or to work, earn money, but have trouble finding enough time to training. Another problem area is related to handling possibilities of injury and health damage. The athletes feel that health is important in a life perspective, but that the career demand taking chances. In average the athletes were injured one month of the year. They also experience tensions between the demands of the athletic career where success and performance is important, whereas in life as a whole other factors are much more important.

The paper discusses how childhood, personal development and total life situation during the career can be used to help develop a more comprehensive picture of elite sport careers in the future.

#### S113A-4

### An interdisciplinary approach to research in swimming and golf

**Sanders Ross**

The University of Edinburgh, United Kingdom

*Keywords: swimming, golf, interdisciplinarity*

The purpose of this paper is to present examples of an interdisciplinary approach to analysis of performance. The interdisciplinary approach will be exemplified in swimming

and golf, these being areas of research focus at The University of Edinburgh.

In breaststroke swimming, changes in kinematics in terms of amplitude and timing of the vertical undulations and the movement rhythms, quantified using Fourier analysis, were studied before and after teaching the wave action breaststroke to masters swimmers skilled in conventional breaststroke. In studies of putting in golf, patterns of torque applied to the club were examined to understand how golfers control the putt and can become more consistent. A large number of golfers across all ability ranges are being studied with other independent variables including putting distance.

The main finding of the breaststroke study was that swimmers could modify technique from the well-established conventional breaststroke movement pattern to a wave action movement pattern within a relatively small number of training sessions (<10). Some of those actually improved their performance and adopted the wave action as their preferred technique despite using the conventional technique for many years. Changes included basic kinematics such as ranges of linear and angular motion, stroke lengths and stroke frequencies as well as changes in relative duration of phases, Fourier frequency composition, and Fourier phase angles. The golf putting research has indicated that elite golfers, in contrast to sub-elite and novices, apply torques to the club in a very smooth and rhythmical fashion with slow onset and slow decline of force prior to impact. The reduction in torques by the hands approaching impact may contribute to consistency by ensuring that the club head as achieved the desired speed with a 'plateau' through the period preceding ball contact. This means that small differences in timing of impact do not cause large variations from that judged to be required speed.

## Oral Session

### Psychology 1

### O113B

#### O113B-1

### Movement-related cortical potentials: source analysis

**Di Russo Francesco, Spinelli Donatella**

University Institute of Motor Science (IUSM), Italy

*Keywords: MRCP, ERP, ortica mapping*

To clarify the location and timing of the motor cortical activation in voluntary movement, dipole source analysis and magnetic resonance imaging (MRI) was conducted for the movement-related cortical potential (MRCP).

Fourteen healthy subjects performed single self-paced extensions of the right or left index finger at about 7-s intervals during EEG acquisitions. EEG was recorded from 64 scalp electrodes. During dipole source modeling, a realistic three-layer head model was used as a volume conductor. To identify the number of uncorrelated sources in the MRCP, principal component (PC) analysis was performed, which was consistent with the existence of six sources in the contralateral and ipsilateral sensorimotor (SM1) and medial frontocentral (MFC) areas. The strength of the six dipoles (three dipoles in contralateral SM1, two in ipsilateral SM1, and one in MFC) was then computed over time.

Within the bilateral SM1, activation of the pre-central gyrus occurs bilaterally with similar strength from -1600 ms, followed by that of the pre-central bank from -500 ms with contralateral dominance. Subsequently, the post-central

bank becomes active only on the contralateral side at 150 ms after movement. The timing of the MFC activity is similar to that of the bilateral pre-central gyri.

These deduced patterns of activation are consistent with previous studies of electrocorticography in humans. A future goal of this study is to verify whether the same neural sources are active with the same timing in top-level target shooters.

#### O113B-2

### The sport preference factors and personality traits

**Bosnar Ksenija, Prot Franjo**

Faculty of Kinesiology, University of Zagreb, Croatia

*Keywords: personality, canonical correlation analysis*

With the aim to determine the relationships of sport preferences and personality traits the sample of 1040 male students attending the finishing year at different secondary schools in Zagreb were given six personality questionnaires describing personality under Momiroviæ's model, measuring extroversion, anxiety, aggressiveness, stability of organic functions, dissociation and social integration (Momiroviæ, Bosnar and Prot, 1983), and were given a list of 52 sports to be evaluated on a 5-point scale. The sport preference results were defined as the results of factors extracted by a principle

component analysis with PB criterion of extraction and promax rotation. The relationship of sport preference factors and personality traits was established by a canonical correlation analysis.

Factor analysis of sport preferences resulted in 3 factors defined as (1) factor of outdoor and adventurous sports, (2) factor of sports with marked aesthetic component and (3) factor of team and combat sports. The canonical correlation analysis produced two low but statistically significant canonical correlations ( $r_1 = 0.231$  and  $r_2 = 0.192$ ). The first canonical correlation is determined by a high preference of outdoor and adventurous sports accompanied by the rejection of aesthetic sports, related to non-neurotic, non-psychotic and more extravert personality, with a lower level of social integration.

It was concluded that gender and the developmental period of the subjects could explain the relationship. The second canonical correlation is defined by high values for sports with marked aesthetic components in the first set of variables, related to high values of extroversion and low aggressiveness in the second set. The results suggest that choice of sports with marked aesthetic components in male adolescents can be related to a slightly neurotic, but non-aggressive and highly extrovert personality.

### O113B-3

#### The development of sport preference structures

**Prot Franjo, Gošnik Jelka, Bosnar Ksenija**

Faculty of Kinesiology, University of Zagreb, Croatia

*Keywords: developmental kinesiology*

The aim of this cross-sectional study was to compare latent structures of sport preferences in urban children of different age.

The research was done on four samples of 5th to 8th grade elementary school male pupils, with the total of 685 boys. The sample consisted of pupils from 3 metropolitan schools. The four samples were 11, 12, 13 and 14 years. A list of 52 sports was given to the subjects to be evaluated on five-point scale during regular physical education classes. The latent structure of sport preferences of each sample was established by component analysis with promax transformation of principle axes. The PB criterion of factor extraction was used, and resulted in five factors in all four sets of data. The comparison of four factor solution was done by the congruences of promax pattern matrix vectors.

The factor analyses of four samples resulted in different solutions. Only two factors were found to be similar in all four data sets, one defined as factor of outdoor and adventurous sports, and the other defined as team sports factor with addition of tennis and table tennis. The factors obtained on 7th and 8th grade samples were mutually more congruent than compared with factors obtained on younger subjects.

It was concluded that the intense phase of sport preference structure formation probably lasts few years more than expected regarding simple analyses of popularity of different sports. It is probable that more stable preference structures could be expected some years after entering adolescence.

Giuliano TA, Popp KE, Knight JL (2000). *A Journal of Research* 42 (3-4): 159-181

Weinberg R et al (2000). *International Journal of Sport Psychology* 31: 321-346

### O113B-4

#### Development of evaluation scales to measure attitudes, beliefs, perceptions of control, and intentions to engage in leisure-time physical activity among pre-adolescent boys and girls

**Kerner Matthew**

Long Island University, United States

*Keywords: theory of planned behavior, leisure-time activity, pre-adolescent children*

Few researchers have explored the usefulness of the theory of planned behavior in predicting leisure-time physical activity among young children. In a review of these papers, there appear to be few tests to assess this model within a population of pre-adolescent children. Those scales published either do not address each of the theoretical variables or appear better suited for other populations. Therefore, the purpose of this study was to develop evaluation scales that would enhance the understanding of the theory of planned behavior with respect to the attitudes, beliefs, perceptions of control, and intentions to engage in leisure-time physical activity among pre-adolescent boys and girls.

The study population included 127 boys and 149 girls, aged 10 to 14 years. Generation of items and establishment of content validity were performed by professionals in exercise physiology, physical education, and clinical psychology. Both unipolar and bipolar Likert-type scales with seven response choices were developed.

Following the revisions, 22 items were retained in the Attitude to Leisure-Time Physical Activity Scale, 10 items were retained in the Expectations of Others Scale, 3 items were retained in the Perceived Control Scale, and 17 items were retained in the Intention to Engage in Leisure-Time Physical Activity Scale. Correlation coefficients for the total instruments were significantly positive for adequate stability and internal consistency, ranging from  $\alpha = .76$  to  $\alpha = .89$ .

The Attitude to Leisure-Time Physical Activity, Expectations of Others, Perceived Control, and Intention to Engage in Leisure-Time Physical Activity Scales have content validity and good internal consistency reliability for middle school boys and girls. They are short, easy to administer, and complement the variables of the theory of planned behavior as applied to leisure-time physical activity. Studies of predictive validities are underway, after which would be available to exercise and physical activity specialists interested in assessing interventions pertinent to achieving national physical activity and physical fitness objectives.

### O113B-5

#### The effect of motivational climate on determinants of cheating among competitive Norwegian youth football players

**Miller Blake W, Roberts Glyn C**

Norwegian University of Sport Science, Norway

*Keywords: motivational climate, moral functioning, cheating*

Cheating in sport occurs on a regular basis. Achievement goal theory (Nicholls, 1989) offers a conceptual foundation for inquiry into the precursors of cheating. Specifically, recent research has identified that player perception of the motivational climate may affect their understanding of appropriate and inappropriate behaviour in competition (e.g., Miller et al., in review; Ommundsen et al., in press). Thus, the

purpose of this study was to investigate the effect of perceived motivational climate on determinants of cheating in competitive youth football.

Participants were 261 (n=163 boys, n=98 girls; 13-14 years) Norwegian youth football players. Motivational climate, moral functioning, sportpersonship, and aggression were measured by questions designed by Bredemeier (1985), Duda et al. (unpublished), Gibbons et al. (1995) and Vallerand et al. (1997). Factor analysis on the perceived motivational climate responses revealed two reliable factors representing performance and mastery climates. The social-moral variables (i.e., moral functioning, sportperson ship, aggression) were deemed valid and reliable for use in subsequent analyses.

Canonical correlation analyses were conducted with perceptions of the motivational climate as predictor variables and moral functioning, sportperson ship and aggression as criterion variables. A significant function emerged representing a high performance/low mastery climate. This function was associated with overall low moral functioning, as well as disrespect for rules and officials and legitimizing aggressive behaviour in football.

Results revealed significant associations between a high performance climate and overall low social-moral functioning. Specifically, coaches that equated success to winning impressed upon their players that low moral functioning, low sportperson ship and the use of aggression were acceptable trade-offs in order to avoid losing. In conclusion, our study highlights how influential coaches likely are to help players perceive the motivational climate and how this may therefore effect how players interpret the precursors of cheating in competitive sport.

Bredemeier BJ (1995). *J of Sport Psych* 7: 110-124.

Duda et al (unpublished).

Gibbons et al (1995). *Res Q Ex Sport* 66: 247-255.

Miller et al (in review).

Nicholls JG (1989). *T competitive ethos and democratic education*.

Vallerand et al (1997). *J App Sport Psych* 16 : 126-140.

## O113B-6

### Cohesion in team sports and its stability over a season

Lau Andreas, Hoffmann Antje

Martin-Luther-University of Halle-Wittenberg, Germany

*Keywords: basketball, performance, group-cohesion*

Prior research in group cohesion of sports (Widmeyer, Carron & Brawley, 1993; Wilhelm, 2001; u.a.) confirms our belief that it is necessary to focus on typical social-psychology claims and special conditions of games for modeling group dynamic processes and their measurements. This allows for analysis of the effects of team-building interventions. The fundamental message is that there are many personal and group items used to describe the phenomenon of group cohesion.

Past analysis by our research group resulted in a new measurement of cohesion in performance oriented team sports (Lau & Stoll, 2001, 2002).

The questionnaire (MAKO-02) includes 19 items; these can be subdivided into the categories of social and task oriented cohesion. Since this questionnaire has been determined as valid and reliable, it will be used in our future research. The primary purpose of this research will be to determine whether task and social cohesion are stable throughout the season. Secondly, we will analyze if the success of the teams can be inferred by the presence of the subdimensions of team cohesion. We expect our results to correlate with those of Wilhelm (2001) and his social-motivation behavior model which show that successful teams have high levels of task cohesion.

Stability of the cohesion dimensions has not yet been confirmed by the results of past studies. We will use our MAKO-02 model with two teams from the Basketball-Saxonia-Womens-League during the 2002-2003 season and collect data five times during this season. The final placement of the teams in the league standings will be used to determine the success criterion. The last data assessment will take place in April 2003.

After four points of measurement, our results show the following tendencies: 1.) At measurement point 1, the two teams differ significantly as in social as well as in task-cohesion, 2.) There are no significant changes in the two subdimensions over time and independantly from success.

In contrary to our expectations, we found that the team B (which is ranked lower in the league) showed higher cohesion values compared to the team A (ranked higher in the league). Our results indicate that team cohesion seems to be a more time stable construct.

Lau, A. & Stoll, O. (2001). *Zum Zusammenhang von Mannschaftskohäsion und Leistung im Eishockey*.

Lau, A. & Stoll, O. (2002). *Lässt sich Leistung über Gruppenkohäsion prognostizieren?*

Widmeyer, W.N., Carron, A.V. & Brawley, L.R. (1993). *Group cohesion in sport and exercise*.

Wilhelm, A. (2001). *Im Team zum Erfolg*. Lengerich: Pabst.

## Oral Session

## Physiology 6

O113C

## O113C-1

**Influence of  $\beta$ 1-Selective adrenergic blockade on the deflection of the heart rate performance curve****Hofmann Peter, Wonisch Manfred, Schwabberger Günther, Pokan Rochus, Von Duvillard Serge**

Karl-Franzens University of Graz, Austria

*Keywords: heart rate, anaerobic threshold, beta1-blockade*

Heart rate deflection may be used for non-invasive determination of the anaerobic threshold. In a certain number of subjects no deflection can be found questioning the physiological basis of the concept.

Aim of the study was to investigate the influence of the highly  $\beta$ 1-selective adrenoceptor antagonist bisoprolol (B) on the degree and the direction of the HRPC.

16 healthy male subjects (age: 24 $\pm$ 4 yrs) randomly received oral placebo (P) or 5mg B. Subjects performed a maximal incremental cycle ergometer exercise test (20W/min). The first (LTP1) and the second (LTP2) lactate turn point, the heart rate turn point (HRTp) as well as the degree and the direction (kHR) of the HR performance curve (HRPC) were calculated by means of computer aided analysis.

HR was significantly reduced at rest and at all work load levels in B (LTP1 - P:125 $\pm$ 13; B:105 $\pm$ 9 bpm, LTP2 - P:165 $\pm$ 12; B:134 $\pm$ 9 bpm, HRmax - P:189 $\pm$ 11; B:164 $\pm$ 14 bpm). kHR was significantly different (B: -0.25  $\pm$  0.34; P: 0.33  $\pm$  0.42). The change of kHR from P to B was significantly related to kHR ( $r=0.644$ ,  $P<0.01$ ) with a greater decrease in cases of regular HRPC response and almost no change in cases of negative kHR in P. HR at LTP2 was significantly related to kHR ( $r=0.784$ ,  $P<0.001$ ). The more kHR was positive in P the more pronounced the decrease in B was. HRTp could be detected in all subjects in P but only in 12 subjects in B. Power output (P) at LTP2 and at the HRTp were not significantly different. B sign. influenced the time course (kHR) of the HRPC.

This indicates differences in number and/or sensitivity of adrenoceptors in the investigated subjects. Subjects with a regular HRPC showed a more pronounced effect of B at LTP2 than subjects with a non regular HRPC did. They presumably have a lower responsiveness to catecholamines already in P. The distinct increase of HR above LTP2 may be related to the sharp increase of catecholamines at LTP2 overriding the effect of B. The deflection of the HRPC in P used to detect anaerobic threshold may be suggested due to  $\beta$ 1- receptor saturation above LTP2.

## O113C-2

**Can the first ventilatory threshold be the maximal lactate steady state?****García Augusto, Benito Pedro, Pacheco Jose, Calderón Francisco, Meléndez Agustín**

INEF (UPM), Spain

*Keywords: cycling, maximal lactate steady state*

The rising interest in the knowledge of the load or intensity, in which our athletes do not accumulate lactate, pushes investigators to study simplified ways of determining it,

avoiding the classical invasive ways of continuous tests (Billat et al., 1994; Harnish et al., 2001; McLellan and Jacobs, 1993; Carter et al., 2000). The aim of the study was to prove that the intensities associated to the maximal lactate steady state (MLSS) and the first ventilatory threshold (VT1) are similar in load, heart rate (HR), oxygen uptake (VO<sub>2</sub>) and lactate concentration (La).

Ten subjects, endurance athletes (cyclists and triathletes) aged 23 $\pm$ 3.7 years and weighing 67.2 $\pm$ 5 kg that were perfectly adapted to these kinds of tests, did two effort tests on the cycle ergometer. The first one consisted of a ramp protocol, increasing 5 watts every 12 seconds (25 WATS $\cdot$ sec<sup>-1</sup>). The second test was a Billat 'Double Intensity' test (Billat et al., 1994), at intensities of 50% and 70% respectively of the maximal oxygen uptake (VO<sub>2</sub>max). Once the normality of the variables was analysed with a Kolmogorov-Smirnov test, a student paired T-Test was applied. Also a Pearson correlation of the variables that were analysed was done.

The results show that there was no significant difference between load at MLSS and VT1 ( $t(9)=1.772$ ,  $p=0.098$ ). No significant differences were found either in lactate concentration for each variable, except for the heart rate ( $t(9)=4.020$ ,  $p<0.01$ ) and VO<sub>2</sub> ( $t(9)=4.049$ ,  $p<0.01$ )

The main conclusion of the study is that load can be used to standardize the intensity at which the MLSS occurs with a conventional ramp protocol. Significant differences were shown in other variables of the study for MLSS, probably because of the differences in booth tests (for determining VT1 and MLSS) which would justify the different manifestation of these variables in two different tests.

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## O113C-3

**Load profile in adolescent and adult triathletes****Reer Rüdiger, Braumann Klaus-Michael**

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*Keywords: cardiovascular, loads, triathlon*

Due to the increasing popularity of the triathlon in a wide population range, the objective of this study was to assess the cardiovascular and metabolic load of the triathlon in adults and adolescents.

According to experience and amount of training, 27 adults between the age of 20-35 years and 22 adolescents between the age of 12-17 years participated in 4 different triathlon competitions with different distances: advanced adults (AAU, n=12, age: 27.0  $\pm$  4.2 yrs., training hours / week: 11.1  $\pm$  4.7) over the Olympic distance (swimming: 1.5 km / cycling: 44 km / running: 10.3 km), beginner adults (BAU, n=15, age: 23.5  $\pm$  2.6 yrs., training hours / week: 0.7  $\pm$  0.8) over 0.3/15/3.5 km, advanced adolescents (AAO, n=12, age: 15.3  $\pm$  1.9 yrs., training hours / week: 7.5  $\pm$  3.5) over 0.5/23/5 km and

beginner adolescents (BAO, n=10, age:  $14.7 \pm 1.6$  yrs., training hours / week:  $0.9 \pm 0.8$ ) over 0.3/16.5/3.2 km. BAU achieved significantly ( $p < 0.001$ ) higher average heart rates ( $179.5 \pm 9.6$  vs.  $163.0 \pm 13.7$  bpm) than AAU. In individual cases average heart rates up to 199 bpm were measured among BAU. BAU attained significantly ( $p < 0.05$ ) higher blood lactate concentrations than AAU ( $8.0 \pm 1.8$  vs.  $4.8 \pm 2.2$  mmol/l). Among the adolescents were no significant differences regarding average heart rates (BAO:  $182.6 \pm 7.1$ ; AAO:  $179.6 \pm 9.3$  bpm) as well as lactate concentrations (BAO:  $6.3 \pm 2.0$ ; AAO:  $6.1 \pm 2.6$  mmol/l). With reference to the subjective rating of perceived exertion according to the Borg scale, the beginners (BAU:  $14.9 \pm 1.6$ ; BAO:  $14.7 \pm 1.6$ ) assessed their physical strain lower than the advanced (AAU:  $15.8 \pm 0.9$ ; AAO:  $15.5 \pm 1.0$ ).

This data demonstrates that a triathlon competition causes quite a high cardiovascular and metabolic load especially among the beginners. Reasons for the lower heart rates and lactate concentrations of the AAU are due to their higher aerobic capacity and their longer competition distance. Differences between adults and adolescents are generated by the greater frequency-accentuated response of the adolescent heart and the lower anaerobic capacity of the adolescents. The relatively low rating of perceived exertion among the beginners indicates that inexperienced persons are not able to assess their load in an adequate manner.

#### O113C-4

### **Serum electrolyte concentrations and hydration status are not associated with Exercise Associated Muscle Cramping (EAMC) in triathletes.**

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*Keywords: muscle cramps, dehydration, serum electrolytes*

The aims of this study were to compare the serum electrolyte concentrations and hydration status of cramping and control Ironman triathletes and to record the electromyographic (EMG) activity of a cramping and control muscle during recovery.

Triathletes suffering from acute Exercise Associated Muscle Cramps (EAMC) after the race formed the cramping group (CR, n=11). Non-cramping triathletes matched for race finishing time and body mass formed the control group (CON, n=9). All subjects were weighed pre- and immediately post-race. Baseline EMG was recorded from the non-active control muscle (triceps) and the most severely cramping lower limb muscle (quadriceps, hamstring or calf) of the CR group. EMG (mV) was recorded at the beginning of every minute for a 10-minute period during recovery. Blood samples were drawn from both the CR (n=9) and CON (n=9) groups during recovery for the analysis of plasma magnesium, sodium, potassium, chloride concentrations, glucose, haemoglobin and haematocrit.

There were no significant differences between the CR and CON groups for pre- or post-race body mass or percent (%) dehydration. Post-race sodium concentration was significantly higher ( $p = 0.01$ ) in the CON group than the CR group ( $142.7 \pm 3.0$  versus  $139.5 \pm 1.7$  mMol.L<sup>-1</sup>) but this was not clinically significant. There were no significant differences between the two groups for post-race serum electrolytes, glucose, haemoglobin concentrations or haematocrits. EMG activity (mV) was significantly higher but more variable ( $p < 0.05$ ) in the cramping versus control muscle at 0, 3, 4 and 5 minutes of the 10-minute period.

EAMC is not associated with % dehydration or clinically significant disturbances in serum electrolyte concentrations. The increased baseline EMG activity in the localised force-producing cramping muscles may reflect a heightened muscle activity possibly associated with muscle fatigue.

#### O113C-5

### **Physiological changes of two independent four-member groups during 650 km expedition across the Greenland glacier: The Northern Cross Expedition 2001**

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*Keywords: strength, endurance fitness, isokinetic testing*

Knowledge of the response and adaptation of humans to extreme environmental conditions is very valuable for the preparation of expeditions experiencing such conditions and to prevent adverse situations. The purpose of the Northern Cross Expedition 2001 in May 2001 was to investigate physiological and psychological changes during this 3 week cross country skiing expedition. In this paper we report the physiological fitness characteristics and changes during this expedition.

The study collected physiological profiles from eight participants (7 male and 1 female) before and after the expedition. After a 2 day ascent the group split into 2 randomized teams and proceeded to preset coordinates that took the groups below each others' horizon, effectively isolating the teams. Several fitness parameters were measured during a standardized endurance fitness test on a treadmill and limb strength was measured using a KIN/COM isokinetic testing equipment.

There was a significant 8-18% decrease in strength after the expedition ( $F[1;284] = 26.29$ ;  $p < 0.0001$ ). The loss was more for the legs than the arms ( $F[1;284] = 12.67$ ;  $p = 0.0004$ ) and more for the dominant extremities (right arm and left leg) than the opposite extremities ( $F[1;284] = 4.47$ ;  $p = 0.04$ ). Furthermore, for one of the two groups the loss was more for the extensors than the flexors ( $F[1;284] = 6.63$ ;  $p = 0.01$ ). There were no significant changes in endurance time and maximal oxygen uptake in the treadmill test. However, there was a significant body weight loss ( $F[1;6] = 12.06$ ;  $p = 0.01$ ) and decrease in the thickness sum of 5 skinfolds ( $F[1;6] = 51.67$ ;  $p = 0.0004$ ). There was a significant correlation between the decrease in strength and decrease in maximum blood lactate concentration after the treadmill test ( $r = 0.82$ ;  $p = 0.02$ ).

The members of both groups were fit in regards to both strength and endurance. The greater demand for aerobic endurance than strength could explain the observed decrease in strength.

O113C-6

### Effect of water versus carbohydrate-electrolyte fluid replacement on the physiological and subjective response to prolonged marching in the heat

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**Keywords:** *heat, hydration, carbohydrate*

This study aimed to determine whether carbohydrate-electrolyte fluid replacement offers additional benefits to water with regard to exercise performance, physiological and subjective strain, and hydration status during prolonged marching in the heat.

In a randomized, crossover design, 14 male volunteers walked on a treadmill on two occasions in an environmental chamber maintained at 35°C, 55% humidity, 600W solar radiation, and 2 m/s wind velocity. On one occasion volunteers consumed water (WA) and on another, at least 3 days apart, a commercially available (Gatorade) carbohydrate-electrolyte fluid (CE), before (5 ml/kg) and every 15-min (3 ml/kg) during activity. Volunteers walked for three cycles of 60-min, or until core temperature reached 39.5°C or until exhaustion, in full combat uniform (13.7 ± 1.4 kg load) at 4.4 km/h and 5.0% gradient. Rating of perceived exertion (RPE) was recorded at 15-min intervals during exercise. Fifteen minutes of seated rest separated each

cycle of activity, during which blood samples were collected and analyzed for plasma osmolality, serum sodium, plasma glucose, and white blood cell count (WBC). Nude body mass was measured before and after activity to determine fluid balance.

No significant differences between WA and CE ( $p > 0.05$ ) were observed for fluid intake (WA 2309 ± 159 vs. CE 2310 ± 154 ml), sweat loss (WA 2538 ± 130 vs. CE 2620 ± 235 ml), urine loss (WA 64 ± 39 vs. CE 104 ± 44 ml), and post-exercise fluid deficit (WA 230 ± 156 vs. CE 308 ± 162 ml). No differences were observed for endurance time, exercise core temperature, or heart rate. RPE was significantly lower ( $p < 0.05$ ) for CE versus WA at min 30, 45, and 60 of cycle 1 and min 15 of cycle 2. RPE continued to be lower at min 30 ( $p = 0.07$ ) and 45 ( $p < 0.10$ ) of marching cycle 2. Plasma osmolality and serum sodium were reduced to a similar extent for WA and CE by the end of marching cycle 3. Glucose concentration was significantly higher ( $p < 0.05$ ) for CE after marching cycle 1 (WA 5.51 ± 0.24 vs. CE 6.50 ± 0.18 mmol/l) and 2 (WA 5.35 ± 0.20 vs. CE 6.39 ± 0.22 mmol/l). WBC was significantly higher ( $p < 0.05$ ) for WA versus CE after marching cycle 2 (WA 11.3 ± 1.0 vs. CE 8.6 ± 0.7 × 10<sup>9</sup>) and 3 (WA 11.4 ± 1.2 vs. CE 9.4 ± 0.8 × 10<sup>9</sup>).

The lower perception of effort associated with increased glucose availability in the present study suggests that carbohydrate ingestion may play an important role in attenuating central fatigue during prolonged exercise in the heat.

## Symposium

### Elite Gymnastics

S113D

S113D-1

### Elastic interactions between gymnasts and the apparatus

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**Keywords:** *gymnastics, elasticity*

Interactions between gymnasts and the performance surroundings are elastic. Gymnasts and the surfaces on which they run, swing, balance and rebound are all elastic. The variety of ways in which these interactions can be beneficial in assisting technique, reducing injury and enhancing performance will be considered. Initially the nature of the linked concepts of stiffness and damping will be addressed. Elastic and damping values for a gymnast, springboard, vault, high bar and rings will be considered. Specific examples will focus on the vault and the influence on bar stiffness of varying tension in the support cables.

Experimental measurement and a combination of direct measurement and mathematical modelling were used to obtain stiffness and damping measures. Data were obtained using video recordings of rebound tests. To determine how much influence supporting cable tension had on the stiffness of a high bar, progressive loads were applied in vertical and horizontal directions whilst the resulting deflections were recorded. Dynamic applied loads resulting from a gymnast performing longswings were recorded via strain gauges mounted on the bar combined with 3D video analyses.

The analyses used were based on the FIG apparatus testing protocols and show remarkably consistency. Stiffness and damping values for the springboard were remarkably consistent at 32.6 kN·m<sup>-1</sup> and 156 N·s·m<sup>-1</sup> respectively.

Vaulting horse data were more variable and represent data from the midpoint of the horse (52.6 kN·m<sup>-1</sup> and 849 N·s·m<sup>-1</sup>) whilst data at the approach end of the horse were higher for stiffness (57 kN·m<sup>-1</sup>) and lower for damping (713 N·s·m<sup>-1</sup>). High bar stiffness was 15% lower in the horizontal direction than the vertical, the latter being ~25 kN·m<sup>-1</sup>.

The role of elastic structures in gymnastics varies from managing load to enhancing performance. Interestingly, a gymnast's technique appears to be more important than the elastic nature of the apparatus in reducing loads. Large variations in the tension in the supporting cables appears to have minimal effect on the bar stiffness and hence little influence of the demands placed on an individual gymnast.

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S113D-2

### Tissue response to mechanical loading in elite gymnasts

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**Keywords:** *gymnastics, mechanical load, tissue response*

In general mechanical loading of the musculoskeletal system is a prerequisite for morphological and functional adaptation of biological material. But if stress and strain increase to a certain level and exceed the mechanical limits of the individual structure, mechanical loading may lead to tissue



damage. Gymnastics with its excessive training and impact loading seems to be an excellent model to study the potential of biological structures to adapt. Young female gymnasts have been shown to be particularly prone to overuse injuries, as their musculoskeletal system is still immature. One of the most serious overuse problems for young athletes is the development of abnormal radiological features in the lumbar spine and the thoracic-lumbar transition.

This paper presents data on the potential of the biological structures of young gymnasts to adapt to mechanical loading in sports and contributes to a more detailed understanding of different and/or individual tissue responses to mechanical loading due to sports and physical activities.

Concerning the factors influencing a specific injury or tissue response three steps can contribute to solve the research question: (1) Identification of structures and tissues damaged by a single or repeated mechanical load. (2) The critical tissue strength tolerances should be determined. (3) The mechanical load acting on the tissue in the specific situation of exercise should be quantified/estimated and compared with the critical limits. Based on the identification of potential critical loading in specific gymnastic skills and drills, factors influencing the mechanical loading should be identified and strategies developed to ensure that the mechanical stress stays below the critical limits. It is clear that the identified research strategy implies some weaknesses.

In a five year prospective study the mechanical load on the spine during the daily training was estimated in young elite gymnasts (n=135) through biomechanical measurements and modeling and it's relation to the development of spinal abnormalities and/or morphological adaptation was identified. The impact of muscle strength and the neuromuscular performance during highly loading drills on overuse injuries were studied. Weak connective tissue and muscle potential were used to explain different biological responses to external loading. The strengths of trunk extensor and flexor muscles were tested, neuromuscular performance was measured and clinical examinations were performed. Radiographs and/or MRI pictures were taken from the spine of the gymnasts at different times.

Especially during the adolescent growth spurt the cartilaginous junction between the vertebral body and the ring apophysis at the upper and lower border of the vertebra is a weak point in the disko-vertebral complex. Abnormalities in the anterior ring apophysis are the most frequent finding. Forty-nine findings in 135 gymnasts in the thoracic-lumbar transition support the weakness of the anterior part of the motion segment. Abnormalities in the posterior part of the ring apophysis are infrequent. In our sample no case of posterior disk or vertebra abnormalities could be identified. From the positive findings in the prospectively surveyed sample (n=37) 59,4% of the signs disappeared or decreased the intensity during the three years control, in 40,6% of the cases the severeness of the abnormalities increased. Abnormalities of the vertebral bodies including abnormal configuration, Schmorl's nodes, and apophysal changes are common among athletes (Sward et al. 1992). Hellström et al. (1990) reported a higher frequency of vertebrae with abnormal configuration (e.g. flattening, wedging and increased sagittal diameter) in young athletes than in non-athletes. They argued that healing of moderate vertebral fractures in children may be disturbed by high intensity loading and can explain the abnormal configuration. In subjects with trunk muscle strength below average the percentage of spinal deformities was significantly higher than in the other subgroup.

The response to mechanical loading in the young gymnasts was shown in a significant ( $p < 0.05$ ) increase in vertebral bone mass in comparison to the controls at same age. An increase of BMD during the period of survey was identified in

all the cases. This finding was supported by the BMD data on the former gymnasts which were generally above the average of the normal population. In addition an increase of the vertebral endplate areas in the thoracic and the lumbar vertebrae was found. Surprisingly the water content of the disks of the young gymnasts (9 to 13 years) was significantly higher than in the controls. This finding corresponds with a moderate greater disk height of the gymnasts in comparison to the controls. In the older gymnasts (14 to 19 years) a first tissue ageing was identified. It is of interest that age of the material (even in the young gymnasts) of the disk explained 22,4% of the variance of the disk Tw2 signal (water content) whereas only 11,2% was explained through the mechanical loading. 66,4% of the Tw2 variance could not be explained by load or age. This indicates that genetics should not be underestimated when considering biomaterials strength and tissue response to load.

The prospective data indicate some remarkable tissue responses to the induced loading. These responses are an increase of bone mass, an increase in plate area and an increase of water content in the intervertebral disks. The data indicate that mechanical loading at high frequency due to gymnastics seems to lead to morphological adaptations of lumbar vertebral bodies in terms of an increase of the endplate area if the mechanical loading is within the physiological window of tissue loading capacity.

Hellström M, Jacobsson, B, Sward, L, Petersen, L (1990). *Acta Radiol.*, 31, 127 - 132. Sward, L. (1992). *Sports Medicine* 13, 5, 357-364

### S113D-3

#### **Mechanisms influencing peak loading at gymnasts' shoulders during swinging elements on rings in men's artistic gymnastics**

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*Keywords: gymnastics, technique, simulation, elasticity*

Gymnasts experience internal forces in excess of 4.5BW at each shoulder when performing longswings on rings. Loads of this magnitude are associated with pain and a greater risk of injury to the shoulders (Brüggemann, 1987; Caraffa et al., 1996). Based on the intuitive belief that elasticity is important in limiting peak loads, the world governing body demands that manufacturers include elasticity in the apparatus. However, the interaction between gymnast and apparatus when swinging is complex and other mechanisms which affect peak loads may exist. Sprigings et al. (1998), for example, highlighted the potential importance of technique in altering loading. This study therefore investigated the relative contributions of apparatus elasticity and technique in limiting peak forces experienced at the shoulders to tolerable levels during longswings.

A three-dimensional simulation model of a gymnast swinging on rings, incorporating apparatus elasticity, gymnast compliance and driven using the gymnast's technique, was used (Brewin et al., 2000). The model was evaluated against three-dimensional force and kinematic data for backward and forward longswings, which provided estimates for the elastic properties of the modelled apparatus and gymnast. Eight simulations, based on the evaluated longswings, were conducted in order to examine the contributions of technique and apparatus elasticity in limiting peak loads to magnitudes obtained during actual performances.

The model simulated the motion of the gymnast and rings cables to within 1.0% and 7.5% respectively. The RMS

difference between the actual and simulated combined cable tension was 297N (backward) and 385N (forward). Removing the arching-to-piking (backward) or piking-to-arching (forward) aspects of technique provided an increase in combined peak loading at the shoulders of 2.6BW and 4.9BW respectively. Swinging on a rigid rings apparatus produced increases in combined peak loading (0.6BW and 0.4BW) which were similar to when only lateral arm movements were omitted (0.7BW and 0.3BW).

A gymnast's technique is the most important mechanism in limiting peak loads experienced at the shoulders to tolerable levels. Although apparatus elasticity assists in limiting peak forces when swinging, its importance is less than might be expected.

Brewin, M.A. et al. (2000). *Hum Mov Sci*, 19: 717-736

Brüggemann, G-P. (1987). *Med Sports Sci*, pp. 142-176

Caraffa, A. et al. (1996). *Knee Surg, Sport Traum & Arth*, 4: 39-42

Spriggins, E.J. et al. (1998). *J. of Biomech*, 31: 27-35

### S113D-4

## Bar reaction forces in long swing techniques of male and female gymnastics

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Keywords: gymnastics, technique

Giant swings prior to dismounts and flight elements have the goal to supply a high amount on kinetic energy. That is the basis for a big flight height and for the required turns around the body axes. Elite male gymnasts and an increasing number of elite female gymnasts execute the dismount giant swings backward at the horizontal bar and uneven bars with a technique that was created by the Chinese gymnast Tong Fei in the eighties. We call this technique Tong Fei Technique in accordance with the F.I.G. custom. Previous investigations for giant swings were above all concerned with energetic problems. We attempted to answer the question, which importance the force time structure has for an effective execution of the giant swing backward. In what a way does the optimization of the rotation and translation become possible?

Video recordings and horizontal bar respectively uneven bars dynamometers were used synchronously in order to collect kinematic and dynamic data during the 1994 and 1997 World Gymnastics Championships. The dynamometers, working with the principle of electric strain measurement, were installed to original gymnastic apparatuses with in co-operation with Spieth company (Knoll et al. 1996).

During giant swings prior to dismounts and flight elements the angular momentum achieves a maximum of 100 kgm<sup>2</sup>/s due to the leg beat. The giant swing maximum is always bigger than the salto angular momentum. This relation is valid in artistic gymnastics for all preparing elements (PE) prior to dismounts and flight elements on the apparatuses. It includes the reduction of the angular momentum of preparing elements in upswing (hang apparatuses as rings), push-off (vault) or take-off (floor, beam) to dismounts and flight

elements (Knoll 1993). It is generally valid:  $L_S/L_{PE} < 1$ . - A transformation of rotary motion into translation occurs in upswing. The angular momentum is reduced and the vertical velocity increases. That is an important sequence of events during the upswing. Therefore the release does not occur at the moment of the maximum angular momentum, as one would expect. In this short movement section from maximum angular momentum up to release, essential control movements occur for the flight element. The gymnast above all use the shoulder joint angle for optimization of angular momentum and vertical release velocity, either for a stretched double salto (big amount of angular momentum) or for a tucked double salto (middle amount).

Giant swings prior to dismounts and flight elements show a double peak in the force time course. The 1<sup>st</sup> force maximum is created in the down swing by the marked transition into an arched posture and is designated in connection with the traditional technique as "hang". It coincides with the angular momentum maximum. The 2<sup>nd</sup> force maximum is the result of beat leg swing. It shows the bigger value and amounts to the 8fold body weight at the horizontal bar and the 5½fold body weight at the uneven bars.

It is interesting that, in the case of effective sports technique, the temporal distance of the force maxima corresponds to the natural period of oscillation of the oscillation system bar and gymnast or comes close to it. That means the leg beat swing is implemented as a resonant vibration. The natural period of oscillation, determined in vibration tests, ranged from 0.27 to 0.37 s, depending on body mass and chain tension. It is known that great effects (amplitudes of vibration) can already be achieved with small strength values at resonance. The double peaks occur more markedly: on the horizontal bar compared to the uneven bars (because of the lower bar), at Tong Fei technique compared to the traditional technique and during giant swing backward compared to giant swing forward (caused by anatomical conditions). At Tong Fei technique and giant swing backward the gymnasts perform closer to the natural period. The force maxima are about one time body weight bigger in the case of the Tong Fei technique. A greater energy storage in the bar means that which the gymnast can use this for the dismount (Arampatzis & Brüggemann, 1999).

The double peak of reaction force indicates an effective leg swing which generates a high amount on kinetic energy. At the horizontal bar, however, the extreme Tong Fei technique (strong flexion in shoulder and hip joint) does not need to be applied. Other technical solutions with greater joint angles are possible. In general for dismount giant swings forward the same functional relationships (double peak) apply.

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## Oral Session

### Training and Testing 2: Energy Metabolism and Workload

O113E

## O113E-1

#### Calculation of the energy metabolism with empirical data of ergometer test

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**Keywords:** performance diagnostics, simulation, energy metabolism

In competitive cycling the available power and therefore available energy has a great influence on the overall performance in competition. Lately the diagnostics of the energy metabolism in cycling sports has become a major field in theoretical and applied sport science. With common day performance tests it is impossible to evaluate the metabolic background causing a specific physiological response to a load applied to the system.

Based on the model of the regulation and dynamics of muscular energy metabolism from (Mader 1984), current research has made this model applicable for practical use (Weber 2003). Lacking the calculation of the dynamics of high energy phosphate, it became possible to calculate the activation of oxidative and glycolytic metabolism from easy measurable data. Data needed for calculations are maximum oxidative and glycolytic performance and body mass (Weber 2003). The maximum oxidative and glycolytic performance was measured using two short high intense tests on a cycle ergometer. Body Mass was recorded using a standard scale. The modelling state of the energy metabolism is only possible up to power demands equalling 2max. Presupposing that the anaerobic threshold is a state of the energy metabolism where the production and oxidation rate of pyruvate are equal, it became possible to calculate the power output at this metabolic state. All parameters showed a non-linear influence on the power output at AT. The transmission ratio of 2max changes to power output at the AT was greater than the transmission ratio of maximum glycolytic power, which was greater than the transmission ratio of body mass.

The combination of the presented model and ergometer tests build a tool to model the state of energy metabolism in steady state cycling conditions for any cyclists undergoing the needed tests. Therefore this model is usable for precise performance analysis in lab and field.

Mader (1984) *Habilitationsschrift, DSHS Köln*

Weber (2003) *Dipl. A. DSHS Köln*

Six male cyclists of recreational level ( $VO_{2max}$   $61 \pm 11$  ml/kg/min; weight  $69 \pm 1$  kg; height  $174 \pm 6$  cm; age  $36 \pm 6$  yrs) were involved in the study. MLSS was defined as the maximal intensity at which blood lactate does not increase more than 1 mmol/l from min 10 to min 30 of a steady state exercise. In order to find, by trial and errors, an individual workload slightly higher than MLSS (HMLSS), in separate occasions (every 3-4 days), the subjects were submitted to steady state workouts on a SRM ergometer (SRM, Welldorf, Germany). In the first 5 min of a following workout, 50 W were overimposed to the individual HMLSS (50HMLSS), in order to cause an early lactate accumulation over MLSS workout corresponding value; then, from min 5 to min 30, power output was reduced to the individual HMLSS: a relative lactate decrease after the reduction of the power output to HMLSS should be inconsistent with the assumptions that over MLSS, lactate utilisation cannot be further significantly increased. To compare blood lactate values of the two trials Student t-test for paired data was used.

Results show that the individual HMLSS lactate increase from min 10 to min 30 was  $1,28 \pm 0,20$  mmol/l (range: 1,06 - 1,53 mmol/l), supporting the overcoming of the MLSS. In 50HMLSS exercise, at min 5 blood lactate was higher than HMLSS at min 5 ( $7,08 \pm 1,87$  mmol/l vs.  $3,53 \pm 1,10$  mmol/l;  $p < 0,002$ ). From min 8 of exercise, a lactate decrease takes place (with the characteristic exponential shape of lactate disappearance), resulting in a trend towards difference against HMLSS at min 15 ( $5,24 \pm 1,75$  mmol/l vs.  $4,17 \pm 1,24$  mmol/l;  $p = 0,056$ ), and reaching the same HMLSS average value at min 25 ( $5,13 \pm 1,60$  mmol/l vs.  $4,88 \pm 1,31$  mmol/l).

Results of this study show that even at metabolic intensities slightly above MLSS, lactate removal can be increased to an extend enough to overcome lactate production; that is the case in presence of lactate levels previously increased above the corresponding MLSS individual values. As a consequence, MLSS does not correspond to an absolute ceiling or maximal rate of lactate elimination: these generally accepted limitations must be intended only related to lactate concentrations typical of MLSS conditions in different body compartments.

Antonutto G, Di Prampero PE (1995). *J Sports Med Phys Fitness* 35: 6-12

Mader A, Heck H (1986). *Int J Sports Med* 7: 45-65

Stegemann H, Kindermann W, Schnabel A (1981). *Int J Sports Med* 2(3), 160-155

## O113E-3

#### Overtraining and oxidative stress

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**Keywords:** overtraining, oxidative stress, DNA

Overtraining is associated with physiological and psychological alterations. It was hypothesised that during overtraining there is a marked increase in the generation of free radical species due to physical activity and inflammation. The aim of present study was to measure the effects of moderate, hard and strenuous exercise on certain brain functions and oxidative markers of DNA and proteins in different tissues of rats.

## O113E-2

#### MLSS does not correspond to the maximal rate of lactate elimination

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**Keywords:** lactate removal, anaerobic threshold modelling, maximal lactate steady state

The aim of this study was to verify if, according different theories, above the maximal lactate steady state (MLSS), lactate elimination cannot be further significantly increased to such an extend to overcome the formation rate.

## O113E-4

**Cycle intensity effects subsequent running and combined cycle and run performance****Suriano Robert, Bishop David**

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*Keywords: intensity, performance, triathlon*

Research into multi-discipline events, such as triathlon, has attempted to elucidate the effect that one exercise modality may have on subsequent modalities. The aim of this study was to investigate the trade off between cycling and running during a sprint-distance (20-km cycling and 5-km running) cycle-run succession and to determine if an "optimal cycle intensity" exists that would maximise overall cycle + run performance.

Each subject completed an incremental cycle test to exhaustion to determine maximal oxygen uptake and the lactate threshold. The following two sessions required the subject to perform a 500 kJ (approximately 20-km; Palmer et al., 1996) isolated cycle ergometer time trial (CTT) and a 5-km isolated running time trial (RTT). Subsequent cycle-run (CR) performance tests required the subjects to cycle 500 kJ, at various intensities (80 - 100%) of the CTT, followed by a maximal 5-km run. The cycle-run performance tests were separated into 4 categories based on the percentage of the CTT at which the cycling bout was conducted (CR 81-85%, CR 86-90%, CR 91-95% and CR 96-100%).

Subsequent running performance, expressed as a percentage of RTT, was significantly slower during CR 96-100% compared to CR 86-90% ( $103.2 \pm 3.9\%$  v  $98.7 \pm 2.0\%$ ). Overall performance however, expressed as a percentage of RTT + CTT, was maximised when CR 96-100% was maintained compared to CR 81-85%, CR 86-90%, and CR 91-95% ( $102.3 \pm 3.4\%$  v  $115.4 \pm 2.9\%$ ,  $108.4 \pm 2.5\%$  and  $106.6 \pm 3.5\%$ ).

The main finding of this study was that although a reduced cycling intensity during a simulated 20-km cycle leads to a higher velocity during a subsequent 5-km run, the best overall strategy for a sprint-distance triathlon is to sustain the highest velocity possible during the cycling leg. This is the first study to quantify the trade off between cycling and running during a sprint-distance triathlon and to demonstrate that time sacrificed by choosing a lower intensity during cycling cannot be compensated for by an increase in subsequent running velocity.

Palmer, G. S. et al. (1996). *Int. J. Sports Med.* 17(4), 293-298.

## O113E-5

**Workload demands during professional road cycling competition****Heinrich Lothar, Stapelfeldt Björn, Schumacher York Olaf, Blum Andreas, Schmid Andreas**

Medical University Clinic, Germany

*Keywords: cycling, competition, power output*

The central variable to describe physical workload in cycling is the power output deployed by the cyclist to propel the bicycle. Only few data have been published using direct power measurements. The purpose of this study was to describe the workload during professional cycling road races using direct power measurements together with heart rate as an indicator of physical exercise intensity, and to compare these findings to physiological data obtained during laboratory exercise tests. The presented information could

add to the description of performance structure of bicycle racing.

Six professional cyclists were studied during a 5 day stage race. Cycling power (P) was measured directly using a crank based power measurement system (SRM, Jülich, Germany). The device measures the power (Watts) applied by the rider to the pedal. Simultaneously, the system registers heart rate (HR). The data is displayed directly on a microprocessor and stored for further processing.

Prior to the race, every subject performed an incremental cycling exercise test until exhaustion on a stationary cycle ergometer. P and HR at aerobic (aT), anaerobic threshold (iaT) and at exhaustion were determined through lactate analysis.

Exercise testing revealed the following physiological characteristics for the tested cyclists (HR, Power output): aT: 137 bpm, 2,94 W/kg; iaT 163 bpm, 4,57 W/kg, Max 187 bpm, 5,46 W/kg.

During road cycling competition average P ranges between 2,66 and 5,48 W/kg body weight depending on topographical and tactical aspects of the race.

P measurements show, that about 2/3 of the race are performed at intensities below iaT. HR registrations estimate this amount to 80 %.

The description of exercise intensity in cycling is mainly based on HR. However, power is the most appropriate variable to describe the sustained workload. Our data demonstrate that during competition, workload mainly ranges at intensities below iaT on normal stages. HR overestimates the intensity of exercise when compared to power output measurements based on previous exercise testing at low and moderate intensities and tends to underestimate times spent at intensities above iaT. Furthermore, heart rate shows a high inter-individual variability.

The direct measurement of power output during cycling gives an appropriate description of exercise intensity and should be used to characterise workload in cycling.

## O113E-6

**Effects of a rowing-excursion on physiological work capacity****Grabow Volker, Konieczka Jörg, Starischka Stephan**

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*Keywords: performance, rowing, excursion*

A rowing-excursion requires certain physical conditions to do an average amount of 30 - 60 km/day. The aim of the study is a precise diagnostic of the load during a rowing-excursion in comparison to every-day life by measuring the cardio-circulation. An additional aim is the examination whether the work capacity will increase significant after a 6 days excursion in a rowing boat.

Three male students and one male university teacher participated in the study. The physiological load within 6 days of the rowing-excursion and 6 days of every-day life was measured and stored up. Each participant performed 3-step tests (step duration eight minutes, thirty seconds rest between each step) on a Concept II (type C) rowing ergometer before and after the excursion. In addition to the laboratory diagnostics a standardized physical-activity-report was made to describe the individual amounts and contents of training within the time before the excursion.

The specific work capacity increased significant after the excursion within all participants between 10 - 16 watt (4,1% - 11,0%). Besides the compulsory preparation for the excursion (rowing 1h/week) over a period of 10 weeks the participants made additional endurance training (rowing,

biking, running). The daily amount during the tour was  $60 \pm 5$  km. This corresponded to 7 - 8 h/day of pure time of rowing. During the physical activity of rowing the average heart rate amounted to 110 - 120 /min. The individual average heart rates during 12 hours on the excursion were at 102, 100, 104 and 102 /min whereas 76, 75, 83 and 87 /min were the individual values in every-day life. At no time there were heart rate increases above 130 /min.

Although the physiological load during the rowing-excursion was marked as very low, there was a clear increase of the

work capacity. It depended on the individual performance level and the training level how powerful the positive effect was. Even very low stimuli can steer to distinct improvements of the physiological performance ability, if the stimuli continue for many hours a day.

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Thorhauer HA (1995). *Trainingswissenschaft*

## Symposium

### Antioxidants and Gene Regulation in Physical Activity and Aging

S113F

#### S113F-1

#### Hydrophilic antioxidants and adaptative response to oxidative stress

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*Keywords: vitamin C, glutathione, redox-sensitive transcription factors*

Exercise briefly increases ROS levels. Then, metabolic adaptation will occur through modulation of redox-sensitive transcription factors (AP-1 and NF- $\kappa$ B) and endogenous enzymatic and not enzymatic antioxidants. Two of the key antioxidant players are the redox-active glutathione and the thioredoxin/thioredoxin reductase system maintained in the active form by vitamin C.

Adaptive responses were evaluated in two muscle cell lines (rat L6C5 and mouse C2C12 cells) showing different sensitivity to oxidative stress. We investigated specific antioxidant systems [transport and recycling of vitamin C, glutathione content, thioredoxin reductase, AP-1, NF- $\kappa$ B and inducible nitric oxide synthase (iNOS)] and their response to oxidative stress. L6C5 cells have an antioxidant state less efficient than C2C12 cells, as demonstrated by endogenous ROS levels. The susceptibility of L6C5 cells may be related to low levels of thioredoxin reductase expression and vitamin C metabolism, although cells show a glutathione content higher than in C2C12 cells. According to the redox state, a higher baseline of NF- $\kappa$ B activity is observed in the resistant C2C12 cell line; the activity is slightly affected by vitamin C supplementation. By contrast, L6C5 cells show a low NF- $\kappa$ B basal activity, which can be up-modulated by vitamin C supplementation. An opposite behaviour can be demonstrated for iNOS, whose product is a potent inhibitor of NF- $\kappa$ B: sensitive L6C5 cells have higher iNOS levels, thus inhibiting the survival activity of NF- $\kappa$ B. Inhibition of iNOS rescues L6C5 cells from oxidative damage, thus confirming that the two cell lines differ in this regulatory, redox-sensitive pathway. Depletion experiments revealed that GSH may be a key regulator of antioxidant defence, since depleted C2C12 cells showed a significant increase in ROS production and death.

We found that GSH may play a key role also in vivo. Our studies on lymphocytes, derived from healthy young men with different fitness levels, reveal that the reduced/oxidised glutathione ratio is the most powerful biological marker of adaptive responses to oxidative stress associated with exercise. Indeed, biochemical parameters (including total antioxidant activity, vitamin C concentration and expression of heat shock proteins) are not affected by fitness. On the contrary, the reduced/oxidised glutathione ratio changes in

relation to exercise and fitness, with trained subjects showing unchanged ratio after exercise.

#### S113F-2

#### Role of oxidative stress in physical exercise and ageing

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*Keywords: antioxidants, exercise, aging*

Increased amount of free oxygen radicals is associated with ageing, and is believed to be involved in the pathogenesis of atherosclerosis and diabetes. Thus, use of supplementation with antioxidants should in theory prevent or at least delay the progression of these diseases. However, data from large multicenter studies have suggested a detrimental, rather than a beneficial effect of antioxidants in atherosclerosis.

Furthermore, the general acceptance of physical exercise being beneficial fits poorly with the evidence that skeletal muscle generates a number of reactive oxygen and nitrogen species, all of which increase in response to muscle contraction. Hence, recent data indicate that free radicals may regulate gene transcription in response to physical exercise, thus suggesting a possible role in the adaptation to exercise.

This appears to be the case for the pleiotropic cytokine interleukin-6 (IL-6), which is produced locally in the contracting muscle and subsequently released into the circulation. Of note, IL-6 has been demonstrated to possess features of a hormone in several studies. Importantly, it has recently been shown that free oxygen radicals can induce IL-6 in muscle cell cultures via upregulation the redox-sensitive transcription factor NF- $\kappa$ B. In addition, our group has recently demonstrated that antioxidants blunt the release of IL-6 from human contracting limbs, which is accompanied by a markedly attenuated cytokine and hormone response.

Also heat shock proteins (HSP), which are increased in several tissues following exercise, are induced by oxidative stress. Interestingly, low level of heat shock proteins in skeletal muscle is associated with diabetes. Supplementation with vitamin C and E can inhibit the exercise-induced heat shock protein response. However, the increase is only blunted by gamma-tocopherol, which is the predominant form of vitamin E in the diet in the United States, but not alpha-tocopherol, which is the form of vitamin E used in most supplementation studies. These findings demonstrate both specific and complex interactions between free radicals, antioxidants and adaptation.

In conclusion, there appear to be a delicate balance between prevention of oxidative damage and inhibition of the cellular

adaptation, which implicates the need of further investigation before reasonable recommendations concerning use of antioxidants in disease prevention can be made.

### S113F-3

#### Expression of exercise-related genes and modulation by ascorbic acid

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*Keywords: antioxidants, exercise, gene expression*

This presentation will focus on the role of antioxidants in the exercise-induced cellular modification, discussing the signal transduction pathways possibly correlated to ROS. Then, we will discuss our data from in vitro cellular model regarding the effect of ascorbic acid supplementation on genes involved in the signal transduction pathway leading to Vascular Endothelial Growth Factor (VEGF) expression, or to the adaptation of skeletal muscle cells to ROS-induced apoptosis.

In C2C12 mouse myotubes, CoCl<sub>2</sub> treatment miming hypoxia, not related to cytotoxic effects, induces upregulation of VEGF gene, both at mRNA and protein level. Moreover, VEGF activation is related to up-regulation of Hypoxia Inducible Factor alfa (HIFalfa) and iNOS. When exogenous ascorbic acid is added in the cultures, the gene up-regulation exerted by hypoxic treatment results strongly inhibited. Thus, free radicals seem to be involved in the signal transduction pathway leading to VEGF expression in skeletal muscle cells, and ascorbic acid results very efficient in neutralise this effect.

When L6 rat myoblasts are exposed to acute cytotoxic exposure to hydrogen peroxide (H<sub>2</sub>O<sub>2</sub>) (30-100mM), they exhibit a strong induction of apoptosis and chromosomal aberrations. This effect is lowered when muscle cells are adapted to oxidative stress by preconditioning through chronic exposure to low H<sub>2</sub>O<sub>2</sub> concentrations (1-10mM). The acquisition of a resistant phenotype in respect to damage induced by high ROS concentration is known as adaptive response, and it is known to involve the activation of specific gene, such as apurinic/aprimidinic endonuclease (APE). When ascorbic acid is added in culture in the preconditioning period, it completely abolishes the adaptive response only if it is present early during the treatment. This result demonstrate that low ROS concentration induce activation and accumulation of gene products (APE, Bcl-2, a B-crystallin), which determine myoblasts resistance to apoptosis induced by high ROS intensity, and that an excess of exogenous antioxidants prevents muscle cell adaptation.

### S113F-4

#### Exercise, oxidative stress and inflammatory response

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*Keywords: aging, oxidative stress, inflammation*

Intense physical exercise increases the generation of reactive oxygen species (ROS). If the amount of formed ROS is higher than the body's enzymatic and non-enzymatic antioxidant defense capacity, ROS can cause oxidative stress leading to substantial damage to lipids, proteins and nucleic acids. Increasing evidence suggests that oxidative stress is also associated with proinflammatory processes.

Therefore, it has been speculated that oxidative stress (e.g. via NF-kappaB pathways) may be an important trigger in the exercise-induced inflammatory response. Although this hypothesis was confirmed by some investigations, most studies failed to establish a direct influence of ROS formation or oxidative stress on post-exercise inflammation. This may be explained by physiological adaptations within muscles and other tissues induced by regular physical exercise: 1. Physical exercise increases the enzymatic antioxidant defense capacity thereby preventing a considerable amount of oxidative stress. 2. Repeated preconditioning with oxidative stress may reduce inflammatory processes probably mediated by a reduced translocation of NF-kappa-B. Particular with respect to these physiological adaptations, it has been postulated that the age-associated deterioration in size, structure and function of skeletal muscle leads to considerable post-exercise oxidative stress in elder subjects. Although it has been proposed that aging muscles show a decreased gene expression of antioxidant enzymes, recent evidence suggests that regular exercise attenuates oxidative stress and increases the production of antioxidant enzymes, the activity of DNA repair and the resistance against oxidative stress also in aged muscles. In addition, it has been shown that physical exercise restores the age-related decline in peroxisome proliferator-activated receptor alpha (PPAR-alpha) levels. A decrease in PPAR-alpha levels is known to induce NF-kappaB signaling and increase inflammatory cytokine production.

In conclusion, current data do not support a simple cause-effect relationship between markers of oxidative stress and inflammatory processes following exercise. In addition, there is no evidence that elder subjects performing regular exercise are at increased risk for oxidative stress or inflammation.

## Symposium

### Technology and Performance in Elite Sport

S113G

#### S113G-1

#### Technology and speed skating performance

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*Keywords: performance, speed skating, technology*

Current speed skating competitions are heavily influenced by technological and mechanical or biomechanical aspects. For example, the introduction of the klap-skate has lead to

dramatic increases in long track speed skating performance. The shattering of long track world records in the past few years can be directly attributable to the use of the new skate design. The dramatic improvements resulted in a revolution in a sport that used to be very conservative. Skaters are now experimenting more with their skates, suits and equipment. Additionally, the mechanics of the skating movement are being closely studied to develop techniques that can shave off fractions of seconds. Provided an athlete is physiologically and psychologically prepared, small refinements in the

technology or mechanics can dramatically influence his or her performance relative to other athletes.

The dramatic improvements in performance from the klapskate have triggered alternative designs from various inventors and designers. Manufacturers also began further development of the klapskate through several technical changes and improvements. Despite the increase in knowledge about the klapskate design, one fundamental piece of information, which has eluded the speed skating enthusiasts, is how to determine the optimal klapskate pivot position for maximal performance. At this point, the position of the pivot point is placed underneath the ball of the foot somewhat arbitrarily, usually the result of an extensive trial and error process. A project is currently being undertaken to investigate the influence of ankle plantarflexor strength on the optimal position of the klapskate mechanism. Also studies into how alternative klapskate designs affect power output and long track speed skating performance are being conducted.

Speed skating performance is largely influenced by ice friction and air friction (drag). If either of these factors can be reduced, an athlete can travel faster and have an increase in performance. Reducing drag is far more effective than reducing ice friction because about 80% of the energy a skater produces is used to overcome drag while only 20% is used to overcome ice friction. Drag coefficients are influenced by surface friction between the air and the skater. Skin suit design has developed dramatically over the past several years with new materials and even new concepts responsible for substantial improvements in performance.

### S113G-2

#### Technology and running performance

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*Keywords: performance, running shoes, technology*

Running speed is the easiest performance aspect for running shoes to understand. It has been - and will always be the main goal to engineer shoes that enable the athlete to run faster. Besides this direct improvement of performance there might be other aspects that have positive influence on performance. Typical examples are concepts allowing the athlete to run "biomechanically correct" or optimizing climate comfort.

1. There is a need to influence the mechanics of running to increase running performance with a shoe. The metatarsophalangeal joints of the foot are joints where you put energy in during bending and none of this energy is given back to the body during extension. The main idea of the concept is to stiffen up that joint with a stiff and highly bending elastic midsole to optimize bending stiffness and bending elasticity. The first evaluation of this concept was a simulation of a running movement with "normal" and "stiffened" metatarsophalangeal joints which show an energy benefit for the stiff joint version of the model. After product engineering this leads to a performance running shoe with an embedded carbon plate of defined stiffness and maximized elasticity.

2. There is a lot of discussion in biomechanics about biomechanically correct running. For runners who pronate it is discussed if and if yes how much pronation and pronation velocity a good shoe should allow. From a sport industry point of view there is a strong need of shoes following a concept of pronation control as it is well accepted by the market. One of the newest footwear concepts introduced in 2002 is the a<sup>3</sup> technology with a progressive hardness increase of single pieces from the touch down to the medial

area in the heel. It allows the foot to be smoothly slowed down.

3. It is known that running in hot and dry environment normally results in hot feet. While the body's optimum core temperature is 37°C, the foot's optimal skin temperature is between 28 and 33°C where athletes feel most comfortable and where it is speculated that they perform best. The main idea of the ClimaCool™ concept is to cool the feet during running in hot and dry environment and to keep them dryer by wicking away sweat from the skin of the foot and provide optimal cooling through ventilation. Tests have shown that a shoe with this concept decreases the average temperature of the foot by 2°C and moisture by 20% compared to conventional running shoes.

### S113G-3

#### Technology and cycling performance

**Di Prampero Pietro Enrico**

University of Udine, Italy

*Keywords: cycling, biomechanics, top performances*

The mechanical power ( $P_c$ ) required for cycling at ground speed  $s$ , is given by:  $P_c = R_r \cos \alpha M g s + M g \sin \alpha s + k v^2 s$  (1), where  $R_r$  is the rolling resistance coefficient,  $M$  the overall mass (cyclist + bike),  $g$  the acceleration of gravity,  $v$  is the air speed,  $\alpha$  the angle of the terrain with the horizontal and the constant  $k$  depends on the frontal area, the drag coefficient and the air density. Dividing both terms of equation 1 by  $s$  and rearranging, one obtains the mechanical work per unit of distance:  $W_c = M g (R_r \cos \alpha + \sin \alpha) + k v^2$  (2). So, the ratio between the overall work ( $W_c$ ) and the work dissipated against the air resistance ( $k v^2$ ) is given by:  $\text{Tot}/\text{Air} = W_c / k v^2 = M g [R_r \cos \alpha + \sin \alpha] / k v^2 + 1$  (3). Since  $R_r$  and  $k$  are fairly well known for a large variety of barometric pressures and temperatures, cyclist's postures and characteristics of frame, tyres and terrain, equations 1 and 3 allow one to calculate: i) the maximal speed attained and the ratio  $\text{Tot}/\text{Air}$ , and ii) the maximal incline of the terrain that can be overcome, for any given power output, as well as iii) the coasting speed for any given down-slope. E.g.: for a mechanical power of 450 W (approximately equal to the maximal aerobic power of an elite cyclist), the speed attained riding an aerodynamic racing bike in dropped posture, at sea level and 20 °C air temperature, for 75 kg body mass, 1.75 m stature and a 10 kg bike ( $R_r = 0.0021$ ,  $k = 0.155 \text{ N s}^2/\text{m}^2$ ) would be of about 14 m/s on a flat track, in which case the ratio  $\text{Tot}/\text{Air}$  would amount to 1.06. Ceteris paribus, on an up-slope of 2 deg (3.5 %), the speed would drop to 9.5 m/s and  $\text{Tot}/\text{Air}$  would increase to 4.5; coasting down this same slope, the free fall speed would be 18.4 m/s. This same subject, assuming a minimal speed of 1 m/s could climb a maximal slope of 33 deg (54 %). In addition, equation 1 allows one to calculate that, for extremely streamlined human powered vehicles, for which minimal drag coefficients of 0.1 have been reported ( $k = 0.0238 \text{ N s}^2/\text{m}^2$ ), the speed attained on flat terrain with a mechanical power of 450 W would increase to 25 m/s. In a velodrome wherein air could be replaced by pure oxygen at a barometric pressure of 150 mm Hg ( $k = 0.00478 \text{ N s}^2/\text{m}^2$ ) the speed attained by these same vehicles with this same power would increase to 43 m/s (155 km/h !). It is here worth pointing out that at these extreme speeds, these vehicles should move on rails. Whether these deeds can indeed be achieved is a question for technology.

S113G-4

**Technology and skiing performance****Schwameder Hermann, Schieffermüller Christian,  
Niessen Wolfgang, Müller Erich**

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*Keywords: alpine skiing, biomechanics, sport equipment*

Function and design of alpine skis have substantially changed within the past few years. Both, in alpine ski racing and in recreational skiing skis have become much shorter, their side cut has increased to a great extent and binding plates have been introduced. These developments in equipment affected the performance and technique of turning both in ski racing and in recreational skiing substantially. This paper will present some results dealing with the effect of the new equipment and the carving technique on diverse biomechanical and motor parameters in order to explain the changes concerning these aspects.

A carving ski racer and former world cup ski racer performed 8 trials on a well prepared run with both carving (14 m) and giant slalom skis (32 m). Kinematic analysis was performed using 3 video cameras. Ground reaction forces were measured using pedar insoles (Novel). EMG data of 7 leg muscles were collected with the biovision system (Ernst). Turns with carving skis are performed with greater inward leaning angles, greater ski edging angles, higher forces on the inside ski during the steering phase together with higher

activities of the m. peroneus longus and the m. tibialis anterior. Turns with carving skis demand higher balance abilities and improved edge steering abilities in order to be able to ski centrally positioned.

In a field test the effect of three different riser heights on running time in skiing were investigated. 12 runs were performed by a world cup racer. The following parameters were measured: running time, ground reaction forces, the anterior/posterior and the lateral moments, respectively. There was a significant decrease of the running time proportional to riser height. No significant differences concerning forces and moments between the different riser heights could be observed. While the time for the steering phase remained nearly constant, the duration of the edge changing phase decreased proportionally and significantly with riser height.

Alpine skis are not optimised yet for individuals or specific groups in skiing regarding length, shape, stiffness etc. This optimisation most likely affects skiing performance. The bases for this optimisation are measurements of the mechanical characteristics of the material in typical skiing conditions. Currently mobile Kistler force plates are used to measure these forces and moments in order to determine the effect of the material on the measured data. This knowledge is used to optimise the skiing equipment to finally enhance the performance of recreational and competitive skiers.



## Symposium

### New Developments in Sports Nutrition 1

S113H

S113H-1

#### New developments in sports nutrition: introduction and historical overview

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*Keywords: carbohydrate, nutrition, supplements*

The science of sports nutrition is quickly growing to maturity. The last two decades have seen the publication of the International Journal of Sports Nutrition and many sound textbooks such as those edited by Ron Maughan or Ira Wolinsky, or that written by McArdle, Katch & Katch. Many younger scientists like Louise Burke, Stella Volpe and Asker Jeukendrup are involved in sports nutrition research. Private companies like Mars, Isostar, and Gatorade with its Gatorade Sports Science Institute have been fostering sports nutrition research.

In the scientific study of sports and exercise nutrition, some topics are recurring and controversial. Four such topics are addressed in this symposium.

In 1842, Justus von Liebig asserted that vigorous exercise required a high protein intake. Many clever experiments have since shown protein to have only a secondary role as fuel, but the right amounts of dietary protein necessary for optimal exercise recovery and muscle development are still being debated. Dr. Kevin Tipton addresses recent findings on how protein and carbohydrate intake after exercise can influence protein synthesis.

Bernarr Macfadden quoted a successful ultra-marathoner from 1902 who raced on a diet of fruit juice and sweet fruits because "...experiments have amply furnished the proof that the main function of fruit sugar ... is the production of heat and energy. Sweet fruits ... do not burden the digestive tract and less force is required for their digestion". The debate on what type of carbohydrate should be ingested before and during endurance exercise continues. Dr. Roy Jentjens discusses a series of experiments in an attempt to provide more clarity on the positive and negative effects of carbohydrate feeding (like rebound hypoglycemia) before exercise. Then, Dr. Jeukendrup reveals some ground-breaking results on the types and amounts of carbohydrates recommended for use during exercise to improve performance.

In 1906, F.G. Hopkins expressed his conviction that no animal could live -let alone perform optimally- on a mixture of proteins, carbohydrates, and fats of sufficient caloric content, and stated the need for "unidentified accessory food factors". A century later, athletes and coaches strive to find new accessory food factors -in this case nutritional supplements- that will give them the edge to win in the sports arena. Dr. Ron Maughan presents on the current debate about nutritional supplement contamination.

These four topics provide a brief but sound overview of some of the "hot" issues in sports nutrition today.

S113H-2

#### Protein synthesis after exercise: the role of carbohydrate and protein

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*Keywords: muscle, protein synthesis, anabolism*

The metabolic basis for skeletal muscle growth lies in the relationship of muscle protein synthesis to muscle protein breakdown. Muscle hypertrophy occurs only from net protein synthesis, i.e. when synthesis exceeds breakdown. Acutely, resistance exercise results in improved muscle protein balance, but, in the absence of food intake, the balance remains negative. Thus, the impact of exercise on muscle growth and function must be considered in light of the interactive effects of exercise and nutrient intake on muscle protein metabolism.

Evidence from resistance training studies suggests that the chronic response to resistance exercise and/or its interaction with nutrient intake do not account for muscle hypertrophy. Instead, it appears that the accumulation of each individual is acute response to the interaction of exercise and nutrients results in protein accretion. The acute response of muscle protein synthesis to hyperaminoacidemia, either through infusion or ingestion, is additive to that of exercise, resulting in positive net muscle protein balance, i.e. net muscle protein synthesis. Moreover, nonessential amino acids are not required to stimulate net muscle protein synthesis.

There appears to be a dose-response of net muscle protein synthesis to essential amino acid intake, but the minimal and maximal doses have yet to be delineated. Energy intake, per se, appears to have little direct impact on muscle protein balance. Thus, the response of muscle protein metabolism to carbohydrate intake is due to the resulting elevation of insulin. Unlike amino acids, the response of muscle protein synthesis to insulin is not additive to that of resistance exercise. However, the normal stimulation of muscle protein breakdown is ameliorated by insulin, thus insulin does result in an improvement in net muscle protein balance. The response of net muscle protein balance to carbohydrate intake seems to be delayed in comparison to the response to amino acid intake.

Following exercise, results of studies demonstrate that addition of carbohydrate to amino acid ingestion that increases net muscle protein synthesis are somewhat equivocal. Whole proteins and food sources of essential amino acids will also stimulate net muscle protein synthesis primarily through a stimulation of muscle protein synthesis. Whereas, much remains to be delineated concerning the response of muscle protein anabolism to resistance exercise and nutrient intake, it is clear that ingestion on the basis of g/kg of a nutrient does not completely explain the response.

## S113H-3

**Effects of pre-exercise ingestion of carbohydrate on metabolism and performance****Jentjens Roy, Jeukendrup Asker**

University of Birmingham, United Kingdom

*Keywords: cycling, rebound hypoglycemia, substrate metabolism*

Pre-exercise carbohydrate (CHO) feedings may result in rebound hypoglycaemia (4) and this may adversely affect exercise performance. In a series of experiments in our laboratory, we have attempted to systematically examine the effect of different types (2), timing (5) and quantity of pre-exercise CHO (3) on metabolism and time trial performance. It was shown that different amounts of pre-exercise glucose ingestion, varying from 25 to 200 g, had no effect on time trial performance (3). Furthermore, ingestion of glucose 45 min before exercise did not impair exercise performance compared with the ingestion of a noncaloric placebo. It was also suggested that mild rebound hypoglycaemia in the early stage of exercise does not negatively affect time trial performance. In another study (2), we found that ingestion of trehalose (glycemic index (GI) of 67) and galactose (GI of 20) resulted in lower plasma glucose and insulin responses prior to exercise and reduced the prevalence of rebound hypoglycaemia (plasma glucose <3.5 mmol/L) compared with the ingestion of glucose (GI of 100). However, no performance advantage was found following ingestion of galactose and trehalose compared with glucose. Altering the timing of ingestion of CHO resulted in markedly differing glucose and insulin responses prior to the onset of exercise and this also had no effect on time trial performance (5). Of note, when the timing of CHO ingestion was delayed from 15 to 45, or 75 min before the start of exercise, more subjects developed rebound hypoglycaemia (2 vs. 3 vs. 5 subjects, respectively (n=8)).

It has been suggested that the occurrence of rebound hypoglycaemia in trained athletes is related to high insulin sensitivity. However, in a recent study from our laboratory, it was shown that the prevalence of rebound hypoglycaemia (n=10) in 20 trained athletes was not accompanied by higher insulin sensitivity (1).

In conclusion, there was no detrimental effect of pre-exercise ingestion of glucose on time trial performance when 75 g of glucose was ingested 45 min before the start of exercise. In addition, rebound hypoglycaemia following pre-exercise CHO ingestion did not negatively affect performance.

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## S113H-4

**Carbohydrate feeding during exercise: What is new?****Jeukendrup Asker**

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*Keywords: carbohydrate, nutrition, sports drinks*

It has been generally accepted that carbohydrate (CHO) ingestion during prolonged moderate to high intensity exercise can postpone fatigue and enhance exercise performance when the exercise duration is 45 min or longer. The observed improvements in performance with CHO ingestion have been contributed to better maintenance of plasma glucose concentrations and high rates of CHO oxidation late in exercise. Exogenous glucose can provide most of the carbohydrate oxidized during the late stages of exercise. In a recent review we summarized all studies available at that time and reported that exogenous CHO oxidation during exercise does not exceed peak oxidation rates of 1 g/min (Jeukendrup and Jentjens, 2000). We and others have suggested that the absorption capacity of glucose in the intestine is the main limiting factor for the oxidation of ingested carbohydrate with glucose molecules competing for a limited number of glucose transports in the intestine. Work by Adopo et al (1994) and Shi et al (1995) indicated that absorption can be increased by using multiple transportable carbohydrates. Since glucose and fructose are absorbed by different mechanisms (different transporters), we hypothesized that combined ingestion of these CHO (in relatively large amounts) could result in exogenous CHO oxidation rates. Indeed when subjects received a solution providing either 1.8 g/min of glucose or 0.6 g/min of fructose + 1.2 g/min of glucose (Fruc+Glu), peak exogenous CHO oxidation rates were ~55% higher with Fruc+Glu (1.26±0.07 g/min) compared with Glu (0.83±0.05 g/min). This is the first time such high values for exogenous CHO oxidation have been reported. Since then we have obtained similar findings with the ingestion of glucose and sucrose. Interestingly GI discomfort also seems to be reduced when multiple transportable CHO are ingested, providing further indirect evidence that absorption of these mixtures is enhanced. These data provide new insights in the factors that limit exogenous CHO oxidation and provide indirect but strong evidence for a limitation at the level of absorption. Adopo et al. *JAP* 76: 1014, 1994. Jeukendrup and Jentjens, *Sports Med* 29:407, 2000. Shi et al. *MSSE* 27:1607-1615, 1995

## Symposium

### Physical Activity and Neural Cardiovascular Regulation in Health and Disease (EFSMA Exchange Symposium)

S113I

#### S113I-1

#### The effect of exercise training on autonomic cardiovascular regulation: From cardiac patients to athletes

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*Keywords: training, athletes, neural cardiovascular regulation*

Exercise training is increasingly promoted for physical and mental health and as a major factor both in primary and secondary prevention of cardiovascular disease. Part of the beneficial effects of exercise could be ascribed to adaptational changes in the neural cardiovascular regulation. Moderate intensity endurance exercise training has been shown to reduce sympathetic while concomitantly enhancing vagal modulation of heart rate (HR), as reflected by a decrease in low-frequency (LF) and an increase in high-frequency (HF) spectral components of HR variability (HRV). This was accompanied by an increase in baroreflex sensitivity (BRS).

Our group has recently reported a marked increase in HRV and BRS after residential exercise training in a randomized, controlled study obtained in a relatively large population of patients with CAD, either with or without a previous myocardial infarction (1). It thus appears that exercise training is an effective nonpharmacological tool to improve neurovegetative control of the heart in patients with cardiovascular diseases, being associated with cardioprotective effects.

However, the effects of training on neural cardiovascular regulation appear to be strikingly modulated by the exercise training load, in terms of intensity and duration.

In a longitudinal study performed in high performance world class rowers, increasing training load up to 75% of maximum was associated with a progressive resting bradycardia and increased indexes of cardiac vagal modulation and BRS, similar to cardiac patients. However, at 100% training load these effects were reversed, with increases in resting HR, BP, LF component of both HR and BP variability and decreases in HF component of HRV and BRS (up to 50%) in comparison to pre-training levels.

High athletic performances might require adaptational changes in the neural control of circulation that could be different from those brought about by moderate-intensity training. Enhanced sympathetic activation and attenuated vagal inhibition could represent the neurovegetative adaptation for increasing athletic performance. Reducing the inhibitory influences of vagal mechanisms while concomitantly enhancing sympathetic activity might serve to prepare the cardiovascular system to the rapid and wide, even anticipatory, variations in HR, cardiac output, flow redistribution, and muscle perfusion of highly demanding competitions.

#### S113I-2

#### Heart rate variability, blood pressure and hypertension

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*Keywords: blood pressure, heart rate variability, hypertension*

Most studies on relationships between blood pressure and autonomic nervous function, assessed by power spectral analysis of heart rate variability, have used conventional or clinic blood pressure measurements in selected subjects, which may have influenced the results.

We aimed to investigate, in a population-based approach, associations of heart rate and heart rate variability, assessed in basal resting conditions and in response to standing, with conventional blood pressure measured by an investigator, and with ambulatory blood pressure monitoring outside the laboratory.

RR interval and respiration were registered in 614 men and women, ages 25-89 years. After exclusion of subjects with myocardial infarction or diabetes and elimination of unsatisfactory recordings, 549 subjects remained for analyses at supine rest and 515 of these to assess the orthostatic responses. Hypertension was present in 39% of the subjects. The low-frequency (LF) and high-frequency (HF) components of heart rate variability were quantified by use of autoregressive modelling and expressed in absolute and normalized units.

At supine rest, indices of heart rate variability were not independently related to 24 h systolic blood pressure, whereas some indices showed weak associations with diastolic 24 h pressure; the relationships were in general stronger for conventional blood pressure. For example, partial correlation coefficients of the relationships of the LF:HF ratio with systolic pressure were 0.12 ( $P<0.01$ ) for conventional pressure and 0.02 (NS) for 24 h pressure; these coefficients amounted to 0.20 ( $P<0.001$ ) and 0.11 ( $P<0.01$ ) for the diastolic pressures. The decrease of HF power and the increase of the LF:HF ratio on standing were significantly blunted at higher blood pressure, both when measured conventionally and by ambulatory monitoring ( $P<0.001$  for the LF:HF ratio).

Relationships between autonomic nervous function at rest, assessed by use of power spectral analysis of heart rate variability, and conventional blood pressure, can at least partly be ascribed to the influence of the measurement conditions, whereas the orthostatic autonomic responses appear to be influenced by blood pressure per se.

*Acta Cardiologica 1998; 53: 211-218*

*Journal of Hypertension 1999; 17: 1589-1599*

*Journal of Hypertension 2001; 19: 389-397.*

S113I-3

### Heart rate variability and autonomic cardiovascular control in overweight - differences in state of health and within weight reduction

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**Keywords:** heart rate variability

Adipositas is a fundamental part of the metabolic syndrome and an eminent risk factor for cardiovascular diseases. This condition is associated with a functional reduction of the cardiac system and adaptations in its autonomic control. Based on mathematical transformation of sinus node signals, heart Rate Variability (HRV) is a current method to monitor the influence of the autonomic nervous system on the cardiac function. The present study aims at describing differences in HRV between overweight and healthy sedentary subjects and the extent how alterations within weight reduction are reflected by HRV.

We analysed two age-matched groups (overweight subjects, N=41, 17 men and 24 women, age 48,26±7,75 years, BMI 31,53±2,58 kg/m<sup>2</sup>; ; healthy sedentary subjects, N=20, 10 men and 10 women, age 45,16±5,56 years, BMI 23,43±2,41 kg/m<sup>2</sup>) using HRV short term measurement (VariaCardio TF4, time- and frequency domain) during a standardised 15 minute tilt-test (alternate supine and tilt position for 5 minutes

in each case). In addition N=29 of the overweight subjects were observed during a controlled six month period of weight reduction with HRV measurement. A questionnaire evaluated possible vegetative disturbances on the measured variables. Average values and group differences were calculated. During the standardised tilt test, healthy sedentary subjects showed significantly higher autonomic activity (frequency domain: LF% 79,17±17,08 vs. 62,89±26,25) in comparison to the overweight collective and a better regulation of autonomic cardiac control (frequency domain: HF% 20,84±17,08 vs. 37,12±26,25).

The sympathovagal balance (frequency domain: In LF/HF) displayed significant differences between the groups. Furthermore significant gender differences were observed. Within a weight reduction in the overweight group of 8,47±4,39 kg and 6,63±4,91 % body fat mass, the subjects showed significant differences of the whole HRV parameters, mainly in the supine body position. In this study, overweight persons showed significant differences in the adaptation capacity of their autonomic cardiac control system compared to individuals of normal weight. There is not only a relative shift to a higher level of sympathetic activity but also a reduction of the entire autonomic cardiac activity. Gender differences in HRV could be an actuation to the known fact of gender as a predisposed factor of cardiovascular diseases. Weight reduction comes along with a better autonomic regulation. Its preventive necessity therefore is unalterable.

## Oral Session

### Biomechanics 7: Muscle and Leg Stiffness

O113J

O113J-1

### Leg stiffness in hopping at different effort levels

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**Keywords:** intensity, hopping, leg stiffness

It has been shown that in natural stretch-shortening cycle type muscle actions leg stiffness can be altered by modulating the ground contact time and/or hopping frequency (Arampatzis et al. 2001; Farley et al. 1991). However, it is not clear, whether the leg stiffness changes with loading when preferred (natural) hopping frequency and contact time are allowed. The purpose of the present study was to examine the regulation of leg stiffness and their interaction with jumping performance at different effort levels. Eight male subjects performed repetitive two-legged hopping on a force plate at different submaximal vertical ground reaction force (Fz) levels corresponding to 3, 4, 5 and 6 times their body weight (BW). Hopping trials were videotaped with simultaneous Fz recording. Trials were averaged and leg stiffness (kLEG) was calculated as a ratio of peak Fz to vertical downward displacement of center of mass (DCOM) during the ground contact. Jumping performance was determined as a vertical take-off velocity of the body (Vto).

Fz curve showed a similar shape with gradually increasing effort level from 3 to 6 times BW (p<.001). However, due to simultaneous increase in the DCOM (p<.001) the kLEG remained constant (43-48 kN/m) at different effort levels. The kLEG was not related to the Vto but showed a significant negative correlation to the DCOM (p<.05 - .01) at all BW conditions. In addition, the Vto was related to the DCOM

(p<.05 - .01; BW3-BW5), which in turn showed a significant correlation to hopping frequency (p<.01) at all effort levels.

The main finding of the present study was that despite of the gradual increase in peak Fz from 3 to 6 times BW, the kLEG remained unchanged due to increased DCOM. Although the kLEG can be altered by modulating hopping kinetics (Arampatzis et al. 2001; Farley et al. 1991; Farley and Morgenroth 1999), it seems that with preferred hopping frequency the kLEG is held constant at submaximal effort levels. Secondly, the kLEG was not related to jumping performance, although smaller DCOM (due to higher hopping frequency) seems to lead to the higher Vto. In conclusion, the present data suggests that the kLEG is rather optimized than maximized for required mechanical output in hopping at submaximal effort levels.

Arampatzis A et al (2001). *J Electromyogr Kinesiol* 11: 355-364

Farley C et al (1991). *J Appl Physiol* 71(6): 2127-2132

Farley C, Morgenroth D (1999). *J Biomech* 32: 267-273

O113J-2

### Does the muscle stretch enhance the positive work in vivo

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**Keywords:** efficiency, muscle, muscle stretch

In the present study we aimed to investigate the effect of pretension history on stretch shortening cycle. Also, we intended to determine how much is the positive work enhancement in the previously stretched muscle.

Eight well-trained subjects volunteered in the study. After 15 minutes warm up the subjects were familiarized with the experimental protocol including isometric (IC), concentric (CC), combined isometric-concentric (QR) and eccentric-concentric (SSC) voluntary contractions of the knee extensor muscle in sitting position on a computerized dynamometer (MULTI-CON II). Being acquainted with the protocol, maximum isometric torque (M0) was measured at a joint angle of 30°. Then the subjects were instructed to exert 1.0M0 or 0.5M0 at 30°, then reaching the target torque the driver automatically flexed the knee with 150 J energy or 5.2 rad/s constant velocity. The range of motion was set to be equal for knee flexion and extension. The joint angle at the end of the eccentric contraction (EC) was measured and M0 was determined at this joint angle. After 5 minutes rest, the subjects exerted 1.0M0 or 0.5M0 and having reached the target torque the machine released the leg from static position and the knee extended automatically. Also, the subjects performed knee extension without pretension. When the muscle stretch started at 1.0M0 the angular displacement was  $15 \pm 1.1^\circ$  during EC. The Mec was 1.45 folds greater than M0 at 30° ( $310.3 \pm 12.5$  Nm), but only 1.19 folds greater than M0 at 45° ( $402.3 \pm 13.1$  Nm). The work needed to stretch the muscle was 1.23 times greater than the work done by the muscle during CC in SSC condition. The CCt for QR and SSC was similar, but considerably shorter than for CC. The Wpoz was greater with 8.4 Nm in SCC than in QR, but 2.2 times greater than in CC. When applying muscle stretch at 0.5M0 the angular displacement was significantly greater than at 1.0M0. The torque increased from  $155.3 \pm 8.5$  Nm pretension to  $422.8 \pm 10.5$  Nm during stretch, but it does not exceeded M0 ( $439 \pm 15.6$  Nm) determined at 28°. Wpoz in SSC was 1.5 and 1.9 times greater than that in QR and in CC, respectively. Comparing the two pretension situations Wpoz in SSC and CC was significantly greater at pretension 0.5M0 as compared with Wpoz at 1.0M0.

Cavagna GA, Dusman B, Margaria R (1968). *J Appl Physiol* 24: 21-32

Ingen Schenau GJ, Bobbert MF, Haan A (1997). *J Appl Biomech* 13: 389-415

Tihanyi J, Tihanyi T, Rácz L (2000). *5th Annual Congress of ECSS, Poceedings*, 738

### O113J-3

#### Muscle fascicle behaviour after SSC-induced fatigue

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**Keywords:** fatigue, ultrasonography, fascicle

Exhaustive stretch-shortening cycle (SSC) exercise induces immediate and delayed decreases in mechanical and reflex performance (Horita et al. 1999; Nicol et al. 1996). These deteriorations are coupled with respective changes in stiffness regulation. The present study was designed to investigate how the fascicle profiles of the skeletal muscle are modified during exhaustive SSC fatigue.

10 subjects underwent 100 maximal drop jumps followed by continuous submaximal jumping until exhaustion on a sledge apparatus. The maximal voluntary isometric plantar flexion torque (MVC) together with electromyography activity from the soleus muscle (SOL) were measured before (BEFORE), immediately after (AFTER), 2 hours after (2HOUR), 2 days after (2DAY) and 8 days (8DAY) after the fatigue task. Except

for AFTER, ultrasound technique was utilized to study fascicle behaviour during all these measurement points.

The results indicated that the SOL fascicle length increased in 2HOUR and 2DAY points in passive conditions and in 2DAY point during MVC condition. The fascicle shortening during MVC condition increased in 2HOUR followed by a decrease in 2DAY. Muscle thickness peaked dramatically at 2DAY.

These results can be interpreted to reflect the contribution of the fascicle changes to the mechanical condition of the muscle and consequently of its sensitivity to the stretch induced reflex activation. The reduced pennation angle caused by the increased fascicle length at 2HOUR may favor the force transfer from the fascicle. On the other hand at 2DAY the dramatic increase in muscle thickness is likely to be coupled with increased activation of III and IV afferents. Thus the changes in the fascicles may partly explain the bimodal changes of recovery both in reflex and mechanical performance in human skeletal muscle subjected to exhaustive SSC fatigue.

Horita T et al. (1999). *Eur J Appl Physiol* 79: 160-167.

Nicol C et al (1996). *Eur J Appl Physiol* 72: 401-409.

### O113J-4

#### Effects of muscle history on reflex sensitivity after exhaustive stretch shortening cycle (SSC) exercise

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**Keywords:** muscle fatigue, muscle history, reflex sensitivity

Previous muscle history has been found to affect the characteristics of short latency stretch reflex response. This is also the case for muscle fatigue. The present study was designed to explore whether the mechanisms related to the exercise induced muscle damage can modify the effects of muscle history.

11 healthy males performed very exhaustive SSC exercise on a sledge apparatus. Stretch- and H reflexes were measured pre- and two days post-exercise in both, passive and active (20% of MVC) conditions, while the muscle was static (ISO), lengthening (LEN) and shortening (SHO). ISO was also measured immediately and two hours after fatigue.

The exercise model induced 22.4 % reduction in MVC. The stretch- and H reflex recordings during ISO showed a bimodal recovery pattern. Muscle activity increased the reflex responses in ISO and SHO before fatigue and 2D. In LEN muscle activity reduced the reflex responses 2D. Blood analyses revealed that leucocytes increased after fatigue and peaked 2 hours post exercise (96.2 %). CK continued to increase until 2D (208.9 %).

The results of this experiment support the existence of bimodal recovery from exhaustive eccentric exercise (McIntyre et al., 1996). Relative effect of muscle activity on reflex sensitivity for SHO and ISO was similar before fatigue and 2D, when muscle damage induced inflammation is known to take place (Armstrong et al. 1991). However, for LEN there seems to be a trend for reduced reflex responses 2D. It has been suggested that the second drop in reflex sensitivity could be due to presynaptic inhibition induced by stimulation of the group III and IV muscle afferents (Avela et al. 1999). The trigger for the stimulation could be substances related to muscle damage and the following inflammation (Rotto and Kaufman 1988). Increases in leucocytes and CK support the possibility that muscle damage has indeed taken

place during the present fatiguing exercise. However, since group III muscle afferents behave also as mechanoreceptors, reduced reflex responses with increasing muscle activity during LEN 2D could also emphasize some mechanical factors as a trigger for reduced reflex sensitivity. Increase in intramuscular pressure due to inflammation could be suggested as one possibility.

Armstrong et al. (1991), *Sports Med.*, 12: 184-207

Avela et al. (1999), *J Appl Physiol.*, 86(4): 1292-1300

McIntyre et al. (1996), *J Appl Physiol.*, 80: 1006-1013

Rotto and Kaufman (1988), *J Appl Physiol.*, 64: 2306-2313

#### O113J-5

### Changes in biomechanical properties of children's skeletal muscles in one-year time

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**Keywords:** muscle properties, tensiomyography, muscle differentiation

Motor activity in childhood is extremely important for the general development of a child. Since children's contractile muscle characteristics are mainly reflecting their inherited muscle characteristics, non-invasive assessments of skeletal muscles' contractile properties in children would provide valuable data to use, providing a reliable direction of a child's motor activity towards the most appropriate sports activity.

The presented study consists of three series of measurements of which only two have already been carried out (Dec 2001, Oct 2002). The main objective was to evaluate children's skeletal muscles differentiation. Measured muscles were assessed with the TMG measuring method, based on the muscle contracting principle (Valenic, 1990). 216 healthy children - 114 boys ( $-9.86 \pm 0.56$  yrs) and 102 girls ( $9.80 \pm 0.61$  yrs) participated in this study (i.e. both measurement series) after a written consent was obtained. Firstly, each child performed a 14-metre sprint velocity test and after that TMG measurements with specific warm-up exercises were carried out on the following muscles: m.biceps brachii, m. vastus lateralis, m. biceps femoris and m. erector spinae.

Standard contractile parameters were calculated and compared for both measurement series (2001, 2002).

Results indicate statistically significant changes in the measured contractile parameters for period of one year. Probability density function for normally distributed parameter running velocity shows significant tendency towards higher running velocity.

Skeletal muscles' contractile properties are in tight connection with motor performance. Preliminary studies (Dahmane et al., 2001) revealed statistically significant correlations between contraction time (Tc) and percentage of slow twitch muscle fibers. A decrease in Tc and increase in maximal muscle belly displacement (activation level), both statistically significant, indicate the expected increase in running velocity. Further, statistically significant changes of measured contractile parameters in one year characterize an intensive skeletal muscle development and differentiation in children between the ages 9 and 10. Considering non-invasiveness and selectivity, TMG measurements of skeletal muscles in early childhood could be a useful methodology for the early selection of talented young athletes and the study of motor performance development.

Valenic (1990). *Advances in Ext Control of Human Extremities* 10: 575-584. Dahmane et al. (2001). *Med Biol Eng Comput* 38: 51-55

#### O113J-6

### The active leg stiffness and EMG activity during maximal voluntary movement in the elderly

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**Keywords:** aging, active leg stiffness, counter movement jump

The research results concerning the ability of stiffness as a fundamental aspect of age-associated change are nearly consistent, that the stiffness of joint and leg is higher in older people (Hortobagyi, et al, 1999, 2000). However, the stiffness was introduced in those studies for passive bodies. The purpose of this study was to investigate the differences in neuromechanical regulation of the active stiffness and EMG activities between elderly and young subjects during Counter-Movement-Jump (CMJ).

Ten healthy elderly people (age:  $68.6 \pm 5$  years; height:  $165.3 \pm 4.4$ cm; mass:  $61.7 \pm 9.3$ kg) and 10 students (age:  $24.3 \pm 2$  years; height:  $171.5 \pm 4.6$ cm; mass:  $65.9 \pm 8$ kg) volunteered as subjects. The subjects were asked to perform a maximal CMJ and a Squat-Jump (SJ) on a Kistler force platform while Biovision EMG system was used synchronously to record the ground reaction force and EMG data from rectus femoris and biceps femoris. Leg stiffness during CMJ was defined as  $F_i/D_y$ , where  $F_i$  is the ground reaction force at the transition from eccentric to concentric contraction (lowest position of c.m.);  $D_y$  is the vertical displacement of c.m for this duration. The EMG signals were normalized by SJ data. An independent T-test was used to compare groups by setting the significant level of  $\alpha = .05$ .

The results revealed that the leg stiffness of older subjects was significantly lower than that of younger subjects ( $p < .05$ ) due to the smaller ground reaction force produced at the transition from eccentric to concentric contraction. This phenomenon is inconsistent with the results reported in earlier studies that the leg stiffness is higher for older people. The reason for this is that stiffness measured in those studies was motor-task-specific or passive stiffness. It cannot reflect the ability of the neuromuscular system to regulate stiffness, i.e. the ability of leg muscles to produce force per unit length change. The time data and EMG activities in eccentric contraction phase were not different significantly between groups, while significant difference ( $p < .05$ ) was found for these parameter during concentric contraction phase. Compared to the younger group, the older subjects performed CMJ with a longer time and lower muscle activities in the concentric phase. Since the EMG signals had already been normalized by SJ, these data of CMJ indicated that the activity level of muscles and thus the muscular strength during dynamic reactive movement was decreased with aging.

## Symposium

### Sport Talent: Quo Vadis?

S114A

#### S114A-1

##### Like father, like son: Determinism in superior sport performance

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*Keywords: performance, environment, genes*

The focus of our presentation is to critically review the relative powers of genes and environment, in the variation observed in superior sport performance. In the early 1970's the twin model was used to disclose, to what extent genetic predisposition accounts for inter-individual variability in physiological responses, related to the oxygen transport and utilization during maximal muscular effort. A high heritability index ( $h^2$ ) of 0.93 was found for maximal aerobic power and was concluded, that the variation of this parameter is determined almost entirely, by the variety of individual genotypes (Klissouras, 1971).

One of the criticisms of the classical twin study method is that, it fails to separate the variance attributable to non-shared from shared environmental effects. For this reason more recent studies, using a more elaborate model of analysis, the path genetic analysis, demonstrated, as the early studies did, a high heritability of  $VO_{2max}$ , with genetic influence being mainly additive and environmental influence being non-shared (Fagard et al. 1991, Maes et al. 1996). The twin model and path genetic analysis, have also been used to study the genetic influence in several other genotypes, shown similar results.

What about the relative power of environment? Results from training studies are often used eclectically, to support the notion of either genes or environment. However, genetic dependence does not exclude environmental influences. A highly heritable phenotype does not mean that it is unaltered, fixed and predetermined. On the basis of measurements made in longitudinal twin studies it was revealed, that training cannot modify a phenotype beyond a limit set by the genotype.

It appears that both genes and training are prerequisites. Superior performers are endowed with a high genetic potential for their specific sport. Genetic potential however is not a passive possibility, but an active disposition actualized through hard, prolonged and deliberate training (Klissouras et al. 2001) Training will never erase individual differences, which are due to innate ability and talent. Training can exert its profound effect, only within the fixed limits of heredity.

Fagard et al. (1991). *J. Appl. Physiol* 70:357-362, Klissouras (1971). *J. Appl. Physiol* 31:338-44, Klissouras et al. (2001). *Intern. J. Sports Medicine* 22:250-2, Maes et al. (1996). *Med. Sci. Sports Exerc.* 28:1479-1491

#### S114A-2

##### A model of diagnosing and performance prediction in the individual sports

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*Keywords: diagnostics, prediction, individual sports*

In swimming, a kinesiological diagnostic system, to optimise technique corresponding to individual physical characteristics, has been used since 20 years and was continuously up-dated. The individual data about training history (swimming and dry land), physical characteristics (body structure, flexibility and strength) and performances (per stroke and distance) were integrated in a profile chart. In addition, a quick system of movement analysis by video was developed, allowing reconstructing the flexible body in the two media. To interpret efficiency (per style variant, e.g. flat or undulating breaststroke), the velocity of the body centre of mass was calculated.

To provide appropriate advice and to estimate swimming performances, correlations were studied between performances per event and physical characteristics as well as technical variables. To separate the effect of growth and training, when physical characteristics and performances improved, the data were mathematically converted.

Based on the individual physical profile chart, the theoretical performance on 100m per stroke and per style variant could be calculated at national level with an average error of 3%. Even at international level, 15% of the swimmers did not use the calculated fastest style variant corresponding to their physical characteristics; besides, at national level some swimmers did not use their calculated best swimming stroke. For a lower level, a qualitative diagnosis and talent identification becomes progressively more effective.

#### S114A-3

##### Physiological predispositions of talented footballers

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*Keywords: football, testing, talent selection*

Analyses of match demands provide a framework for setting out physical and physiological requirements for playing football at a high level. Such a template is only partially helpful in view of the multivariate demands, variation between playing position and style of play adopted. The major characteristics include aerobic and anaerobic capabilities, muscular strength and muscle endurance, agility and flexibility. Without a good sense of tactical know-how, these characteristics on their own become useless.

Practice-based models of talent identification lack the precision and validity for use in scientific research programmes. Nevertheless a process incorporating detection, identification, selection, development and perfection can help structure a quasi-scientific approach (Williams and Reilly, 2000). There are indications of a strong genetic component in performance of football but systematic training and

development programmes can strongly influence the determination of talent.

Elite young players may be distinguished from sub-elite on the basis of a comprehensive battery of test items (Reilly et al., 2000). Nevertheless, such batteries may be more useful in talent discrimination than in talent identification. At higher levels of performance such test items fail to separate the more successful players due to the homogeneity of playing abilities. A more holistic approach that employs subjective ratings of coaches can help complement quantitative analyses of player characteristics.

Reilly, T., Williams, A.M., Nevill, A. and Francis, A. (2000). *A multidisciplinary approach to talent identification in soccer. Journal of Sports Sciences*, 18, 695-702.

Williams, A.M. and Reilly, T. (2000). *Talent identification and development in soccer. Journal of Sports Sciences*, 18, 657-667

## S114A-4

### Bioethics and sport talent selection

Miah Andy

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*Keywords: ethics, genetics, selection*

This paper explores the ethical implications of gene selection in sport, based upon a critique of the values expressed and implicit of striving to identify performance genes. Specifically, this paper is concerned with the use of genetic technologies to identify prospective athletes, though it juxtaposes this process of selection with the more accepted process of conventional selection methods. Arguing that neither of the processes is an ethically desirable practice, the paper also explains additional concerns associated with genetic selection. It is shown how the concept of selection in sport promotes a climate of elitism and a way of evaluating others that instils an ethically impoverished view of sport. This analysis is also placed into the broader bioethical context of how genetic information should be used in sport and outside of it, raising issues about athletes' rights.

## Oral Session

### Psychology 2

O114B

#### O114B-1

### A new method to measure competitive anxiety during sport performance

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*Keywords: heart rate, competitive anxiety, retrospective scale*

Competitive anxiety is mostly measured by self report inventories (e.g. Competitive State Anxiety Inventory-2, CSAI-2, Martens et al., 1990). The disadvantage of the use of these self report inventories, is the temporal proximity of anxiety and performance. Because the CSAI-2 only measures before or after the performance, the crucial events during the competition cannot be studied.

In present study, competitive anxiety, measured by heart rate and by a new retrospective self report scale, was studied in eight elite female gymnasts during a balance beam routine on two training sessions and one competition session.

A significant higher heart rate was found in the competition session, compared to the training sessions. For the scores of the retrospective self report scale, as for the performance score, no significant differences between test moments were observed.

These findings are in accordance with Robazza et al. (1999), who recorded higher heart rates in competitive setting in an archer, but found no differences in performance outcome. The discrepancy between psychological arousal (retrospective self report scale) and actual physiological arousal (heart rate) is evidence for the multidimensional nature of anxiety. These results can also be discussed in the light of the catastrophe theory (Hardy et al., 1994). An increase in physiological arousal only leads to performance decrement, if the cognitive anxiety increases as well. Because in the present study, heart rate increased but the scores on the retrospective self report scale stayed constant, no changes in performance were observed. This illustrates

the potential of the new method to give more insight in the anxiety-performance link.

Hardy et al. (1994) *J Sports Science* 12 :327-34

Martens R, Vealy R, Burton D (1990) *Competitive anxiety in sport*

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#### O114B-2

### Fear of failure - the value of psychological intervention

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*Keywords: self-confidence, motivation, performance*

Young athletes are supposed to associate sport with enjoyment and fun, but due to the pressure to perform well there is often little fun and much anxiety. Due to certain circumstances, athletes sometimes experience a slump in their performance. The harder they then train the less improvement they experience at times, which cause them to fall into a negative cycle of poor performance, higher anxiety, less self-confidence and less motivation. In the South African schools coaches, teachers and parents are often advised not to pressurise young athletes and although the spirit of competition is acknowledged as being healthy, the reality is that many youngsters have become victims of a situation in which competition and specifically winning, are primarily valued. More and more High Schools offer scholarships to promising young athletes, expecting from them to perform not only at a high level in their sport but also in their academic work.

In my work with high-school athletes many of them show similar symptoms: e.g. self-doubt, inability to cope with pressure, performance anxiety, decrease in motivation and injuries of some kind. Because of a great emphasis that's been placed on winning by teachers, coaches, parents and at times the athletes themselves, it seems as if some athletes



measure their self-worth, personal development and progress only by their results (1st place). When winning does not happen, their self-confidence as well as ability to maintain self-confidence decreases and performance anxiety increases.

From my work with the young athletes I have come to two conclusions. First, many of them lack in skills to meet the challenges and second, there seems to be an interrelationship between performance, self-confidence, motivation and fear of failure. In this paper I will present a case study to illustrate this phenomenon and will discuss the possible reasons for the distress in our young athletes as well as the value of psychological intervention to lower performance anxiety and to build self-confidence again.

#### O114B-3

### Affective state profiles of athletes prior to best, worst and injured performances

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*Keywords: performance outcome*

We compared affective states experienced by athletes prior to best, worst and injured performances using a mixed methodology.

Volunteer athletes completed an individualised assessment of affect (Hanin, 2000) and a standardised assessment of affect (Brunel Mood Scale; BRUMS; Terry et al., 1999). After describing the circumstances surrounding a best, worst and injured performance, participants listed 1) Positive Pleasant, Facilitating Affect; 2) Negative Unpleasant, Facilitating Affect; 3) Positive Pleasant, Debilitating Affect and 4) Negative Unpleasant, Debilitating Affect. Participants rated the intensity of the affective states listed using a modified Borg category ratio (CR-10) scale. For Injured performance, participants identified affective states stating whether they were helpful or harmful to performance. A subsection of participants (N = 30) completed the BRUMS retrospectively describing how they felt before best, worst, and injured performances.

Individualised assessment resulted in the same affective states being identified for best and injured performances, albeit with different frequency and intensities. Qualitative data reinforced these findings indicating that participants were most likely to be injured when playing well. Analysis of BRUMS scores indicated a significant main effect for differences in mood by performance outcome (Pillai's Trace = .75,  $p < .01$ ,  $\eta^2 = .750$ ). Post-hoc analyses indicated best performance was associated with lower scores on depression and fatigue ( $t = -3.78$ ,  $p < .01$ ;  $t = 2.09$ ,  $p < .05$ ) and higher vigour ( $t = 3.41$ ,  $p < .01$ ) than injured performance. Worst performance was associated with higher fatigue and confusion ( $t = -3.67$ ,  $p < .01$ ;  $t = -2.61$ ,  $p < .05$ ) than injured performance. Best performance was associated with higher vigour ( $t = 4.05$ ,  $p < .001$ ) and lower, depression, fatigue and confusion ( $t = -5.18$ ,  $p < .01$ ;  $t = -5.34$ ,  $p < .001$ ;  $t = -3.45$ ,  $p < .01$ ) scores than worst performance.

Findings show that using qualitative and quantitative approaches to assessing affective states before three performance outcomes produced similar findings. Results indicate that affective profiles before injured performance are closer to successful performance, than unsuccessful, and confirm differences between successful and unsuccessful performance. Applied sport psychologists should acknowledge that psychological states associated with best performance could also be associated with injured performance.

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#### O114B-4

### Perceptual training in football: A longitudinal intervention case study

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*Keywords: football, perceptual training, intervention*

Laboratory studies have revealed perceptual differences between expert and novices in sport (Williams et al 1999). Some study designs are almost completely absent in the literature. Specifically, researchers have hardly used case designs, field designs, intervention designs, or longitudinal designs. In the present study, Gibson's (1979) ecological approach to visual perception was adopted. Visual exploratory activity is essential in this approach, consisting of active movement of body, head and/or eyes to perceive information which is not located immediately before one's face. To guarantee optimal viewing conditions for the eye, football players engage in this kind of activity, often before receiving the ball. Thus, the purpose of this study was to examine the effect of an intervention program initiated to increase the efficiency of one elite football player's visual exploratory activity and to track these processes as they developed over a period of 3 years.

The participant was one male elite football player (20-23 years). The player was videotaped in a total of 12 actual league games, using two cameras - one providing close-up footage and one providing an overview of major game events. A 7-session intervention was given, providing the player with video feedback on his exploratory activity. Interviews were also conducted.

The participant notably changed his exploratory activity pattern after the intervention. Most importantly, the mean exploratory activity frequency (number of explorations/seconds) changed. After an initial decrease in the immediate post intervention period in 1998, the frequency clearly increased 3 years after the intervention. Furthermore, the advanced types of exploratory activity were among the variables that increased immediately after the intervention. These percentages decreased in 2001. Also, the analyses showed that the player's performance improved from 1998 (pre and post intervention) to 2001.

The changes in the player's exploratory activity following the intervention in this study seemed to be accompanied by increases in level of performance and game performance. The intervention, changes in other variables, and the player's developmental history may explain how this has occurred.

Gibson JJ (1979). *An ecological approach to visual perception*

Williams AM et al (1999). *Visual perception and action in sport*

## O114B-5

**Self awareness (self perception) of emotional, psychological and physical states in competition and training sessions in young gymnasts: an investigation****Bertollo Maurizio, Pellizzari Melinda**

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*Keywords: self-perception, IZOF, emotion*

The aim of this study was to investigate the level of self awareness in young gymnasts with regard to the ability to recognize and predict their own emotional, psychological and physical state during competitions and training sessions. This study was conducted considering some theoretical framework of the Individual Zones of Optimal Functioning (IZOF) model, particularly the principle that both positive and negative emotions can exert beneficial or detrimental effect depending on their idiosyncratic meaning and intensity.

Eleven gymnasts, aged from 11 to 15 years, took part in this experience. They participated to regional, interregional and national competitions and they trained four to five sessions weekly. A performance profile comprising nomothetic items and idiosyncratic emotional items was adopted. The Mental Readiness Form-3 (MRF-3) was used to assess competitive somatic and cognitive anxiety and self confidence. Along with the MFR, two items: courage and pain, were adopted representing two main psychological and physical characteristics useful to perform best in gymnastics. The gymnasts were administered the performance profile before and after three competitions and during three training sessions. This study lasted three months. The goals of this study were: a) to point out differences of the intensities of each item of the performance profile reported before and after competitions and b) to point out differences of the intensities of items of the profile referred to the competitions and the training sessions. Means of each item of the performance profile were collected and reported.

Results showed no significant differences between the performance profile before and after competition to demonstrate a high level of self awareness of these young athletes. On the contrary, a different level of tension, worry, and pain was emerged between competition and training session. In particular, during training sessions the gymnasts perceived a lower level of tension and worry and a higher level of pain than in the competition. It can be inferred that these gymnasts, despite their early age and their short competitive experience, were able to well predict and recognize their emotional state in competition.

Findings seem to suggest a mental training intervention to enhance tension and worry during training sessions to improve in the gymnasts the ability to cope with physical and cognitive aspects of the anxiety.

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## O114B-6

**Burnout in elite level athletes: An achievement goal perspective****Lemyre Pierre-Nicolas, Roberts Glyn C, Stray-Gundersen Jim, Treasure Darren**

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*Keywords: burnout, achievement goals*

Burnout has been defined as a state of mental, emotional, and physical exhaustion brought on by persistent devotion to a goal, the achievement of which is dramatically opposed to reality. Recently, researchers have suggested that 'motivation gone away' may play an important role in the onset of burnout. One way to better understand this phenomenon is from an achievement goal theory perspective. According to achievement goal theory, athletes typically enter an achievement setting in a state of ego or task involvement (Nicholls, 1989), a product of the dispositional orientation of the individual and of the situational factors. Goal orientations are orthogonal and reflect differences in how individuals interpret their level of competence and define success in achievement settings. When task oriented, the individual is trying to demonstrate mastery of the task rather than normative ability. Individuals who are ego involved typically strive to demonstrate superior normative ability, or avoid the demonstration of incompetence. Higher competence is achieved when experiencing success where others fail, or with the least amount of effort. This study looked at the achievement goals of elite athletes and how these variables could influence burnout at season's end.

Participants were 141 elite Norwegian winter sport athletes (age 16 to 32). In September, the athletes answered to the POSQ (Roberts et al., 1998), the PMCSQ (Seifriz, Chi & Duda, 1992). Athletes completed the Athlete Burnout Measure (Raedeke & Smith, 2001) shortly after season's end.

Results indicated that athletes high in task goal orientation yielded a negative relationship to burnout, while high ego orientation was related to a devaluation of the participation in the sport at the end of the season. Mastery climate was negatively related to burnout, while a high performance climate is associated with a devaluation of the sport.

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## Oral Session

### Ball Games: Analysis and Performance

O114C

## O114C-1

#### Is game a self-organizing system? (Criticism of some theoretical views on performance analysis by Tim McGarry and his colleagues)

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*Keywords: performance diagnostics, games, perturbation*

The works of Tim McGarry and his colleagues (McGarry, et.al., 1999, 2002; Hughes, et. al., 2001) have moved forward two important theoretical conceptions, which I would like to discuss. The first one is the concept of perturbation "as an incident that changes the rhythmic flow of attacking and defending, leading to shooting opportunity" (McGarry, et. al., 2002, 775). The second is the view on sport competition as a self-organizing system. The purpose of this work is to prove in an open discussion that the above-mentioned theoretical points are not obligatory connected and that the second assumption is wrong.

The introduced concept of perturbation seems very important. It is expressed in the following principles: 1) it is the key to comprehension of the essence and the aim of the game conflict; 2) it makes it possible to raise the efficiency of the performance analysis; 3) coaches are forced to deal with less of the unnecessary statistical information. On the other hand, McGarry et. al. interpret perturbation (a result of an offensive act, usually) as a destabilizing factor in the game's (system's) rhythmical dynamic. Therefore they see the defensive act of the opponent as a restabilizing act or even a reacting "towards the state of homeostasis" (McGarry et. al., 2002, 778) of the system. There are several debatable premises in this suggestion. The primary of them is the unacceptance of the mechanistically made transfer of regularities proper for the motor adaptive activity of living systems on the regularities of human group activity (that is what the authors actually do). Two opponents in game are a couple of subjects. Each side in the game is simultaneously dependent and independent therefore we cannot interpret their couple activity as an "action-reaction" in the frame of the "simple" behavioristic theory explanation, (and this is the second controversial premise). We have to see it in a dialectical relation. I would like to point out that in each moment of a game the team (player) incessantly plans and searches for opportunities to destabilize the playing of the opponent and to create perturbation around the play article (the ball) both in offence and defense. As an assumption we cannot interpret a game as a self-organizing system.

## O114C-2

#### A mathematical-modeltheoretical concept to evaluate the performance relevance of tactical behaviour in the competition of young handball players

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*Keywords: handball, game observation system, performance diagnostics*

According to Schnabel et al (1997, 4) the complex sport performance has to be adequately understood when intending to give recommendations for the training of young athletes (training tasks, training or performance aims, performance diagnostics, training control). From the scientific point of view it was interesting to gain knowledge on the relevance of tactical behaviour applied by junior female players.

For the analysis of the performance structure during matches we applied the mathematical-model theoretical concept by Lames (1991) that is based on interaction theory. Based on that approach we developed a model for the offensive part of the handball match as a process with several states (State-Transition-Model) (Perl, Lames & Glitsch, 2002). The offensive play was modelled on the basis of offensive attempts. Any of these attempts was characterized by succeeding states (Lames 1994). We defined 11 states for each team to illustrate the tactical behaviour in the offensive play. The process of these succeeding steps resp. states can be understood as a Markov-chain with two absorbing states (goal team A/B). Transitions between the states can be defined as tactical behaviour. According to Markov's theory it is possible to calculate the statistical probability that the process is turning into one of the two absorbing states (goal probability). The performance relevance of tactical behaviour was quantified with the help of the difference between the observed and the calculated goal probability based on a changed transition-matrix.

15 matches during the Junior World Championship 2001 (women, final round) were analysed. Our presentation focuses on the transitions between the first state "position attack" and the initiating states.

Considering the mean performance relevance of this tactical behaviour, we found the highest performance relevance for the transition "position attack - initiating feint" (2%) followed by "position attack - initiating transition", "position attack - miscellaneous" (in all cases 1,2%) and "position attack - crossing" (0,6%). But the comparison between winners and losers shows a significant difference (t-test;  $\alpha < 0,05$ ) in the performance relevance of the tactical behaviour "position attack - transition" and "position attack - feint". For the losers the tactical behaviour "position attack - feint" has a higher performance relevance, for winners that is the case for "position attack - transition".

## O114C-3

**The significance of game indicators and their predictive value for winning and losing teams in handball****Volossovitch Anna, Gonçalves Ines**

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*Keywords: handball, game indicators, binomial logistic regression*

Quantitative analysis of performance in Sport Games represents an important component in the coaching process. The purpose of this study is to analyse the prediction value of different game indicators for discriminating the winning and losing teams in handball.

The sample consisted of 77 games from the 18th Men's Handball World Championship. The Pictorial Match Statistics System was used for recording more than 70 offensive and defensive game indicators in each match. The sample games were categorized into two groups according to the game's outcome: winning and losing games (drawn games were not considered). A factor analysis was applied in order to extract the independent components retained in the analysis. These components permitted the reduction of variables to 18 to be included in the model. Binomial Logistic Regression was used to determine which game indicators were associated with the dichotomous variables (win vs lost). The dichotomous variables were defined as win=1, lost=0.

The final model of the logistic regression analysis included 6 variables that influence the game output: number of shots saved by goalkeeper ( $p=0,002$ ), total quantity of shots ( $p=0,007$ ), quantity of blocks ( $p=0,018$ ), side shot efficiency ( $p=0,117$ ) and number of failed passes ( $p=0,132$ ).

The Hosmer and Lemeshow Test showed a good fit for our final logistic model ( $p\text{-value}=0,825$ ) with a prediction value of 84,4%. It means that 84,4% of the games results were correctly predicted.

The obtained results permitted to verify the explicit influence of defensive actions on the game output.

## O114C-4

**Critical moments and basketball game performance****Ferreira Antonio, Gonçalves Ines**

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*Keywords: basketball, game analysis, critical moments*

Basketball game could be seen as a dynamical system (McGarry, et. al.), where small and singular events could introduce some alterations into normal organization of whole parts involved in the contest situations. The kind of events may occur in a short period of game time and their influence could provoke an alteration of the equilibrium relationship between two teams. This paper has two main goals: first, to introduce new criteria that allow us to define the critical moments in the Basketball game, understanding a game as a dynamical and open system; second, to compare the performance of winner and loser teams in these particular moments of the game.

Eighty Basketball games were the sample of this study.

Results demonstrated that winners and losers were significantly different in three performance indicators: efficiency offensive rating, successful 2 point shots and successful fast break shots. These results correspond to empirical feelings of many coaches. They assume that the

fast break (as consequence of a solid defensive team behaviour) and the selection of shots with high levels of percentage in offense, are the most important factors, whereas ball possession is critical for the final result.

Future researches must consider two essential aspects: first, the development of a multidisciplinary concept in the understanding of critical moment in the Basketball game, second, the utilization of multivariate statistics methods for a better comprehension of dynamic game situations.

## O114C-5

**European men's handball at Olympic Games****Skarbalius Antanas**

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*Keywords: handball, sport performance, Olympics*

A number of research studies indicate that contrary to a short period of time (5 years or less), tracking of cardiorespiratory fitness from childhood to young adulthood over a longer period declines considerably. Therefore, the purpose of this study was to present follow-up data on maximal cardiorespiratory function in Saudi young males, and examine tracking coefficient over an 11-year period.

Subjects were 31 young males from a predominantly middle-class with good nutritional status. They were tested twice, at baseline (T1), with a mean age (SD) of 9.5 (1.5) years, and at a follow-up test (T2), with an average age of 20.5 (1.7) years. Graded treadmill running protocol with a constant speed and an incremental elevation was used. An open-circuit spirometry system was utilized for respiratory and metabolic data collection.

Paired samples t-test indicated significant increases in body mass (150%), lean body mass-LBM (120%) and fat percent (66.5%) from T1 to T2. There were no significant changes between T1 and T2 in maximal heart rate ( $197 \pm 6$  vs  $200 \pm 8$  bpm), VO2 max relative to body mass ( $48.4 \pm 7.9$  vs  $48.3 \pm 6.1$  ml/kg.min), or VO2 max relative to LBM ( $57.6 \pm 8.1$  vs  $62.0 \pm 10.4$ ). However, there were significant increases at T2 compared with T1 in VO2 max relative to body surface area-BSA ( $1.84 \pm 0.23$  vs  $1.38 \pm 0.24$  L/min.m<sup>2</sup>), and in O2 pulse index ( $6.99 \pm 1.14$  vs  $9.18 \pm 1.14$  ml/bpm.m<sup>2</sup>). In addition, VO2 max scaled to 0.67 or 0.75 of body mass increased significantly by 20% and 29%, respectively. Ventilatory anaerobic threshold (VAT) relative to body mass decreased significantly from T1 to T2 by 13%. Furthermore, Pearson correlation analyses of cardiorespiratory function relative to body mass revealed considerably low tracking coefficients over the 11-year period, ranging from 0.056 for VO2 max relative to body mass to 0.207 for O2 pulse index.

It can be concluded that VO2 max relative to body mass remained almost the same from childhood to young adulthood in Saudi males. However, VO2 max expressed relative to BSA or raised to body mass to the power of 0.67 or 0.75 increased significantly during the same period. Further, Tracking of cardiorespiratory fitness over an 11-year-period from childhood to young adulthood was low.

O114C-6

**Process oriented analysis of wheelchair basketball technique****Menzel Hans-Joachim, De Oliveira Juliana Torres**

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*Keywords: wheelchair basketball, shooting technique, process oriented analysis*

In wheelchair basketball, every player is classified by an expert rating according to specific skill performance. The classification ranges from 1 to 4.5 points where higher classification means less limitation of movement. The aim of this study was to identify inter and intra-individual movement pattern changes of shooting technique of athletes with different functional classification and to verify if different functional classification might be justified by different shooting techniques.

Shots of eight athletes (two of each classification group) participating in the II Junior World Championships (2001), were filmed in the sagittal plane from the throwing arm side (125 Hz). For each throwing position (3m and 4m in front of the basket) two successful shots were digitized and 12 cinematic variables determined (angles and angular velocities of the shoulder, elbow and wrist; EULER angles and angular velocities of the upper arm, forearm and hand).

In order to analyse the movement pattern, a process-oriented method, described by Schöllhorn (1995) was applied. The time courses of the variables were correlated with 6 orthogonal reference functions which results in a (12 x 6) matrix representing each shot. Subsequently the correlation matrices were compared and a similarity coefficient for every pair of matrices was calculated. The resulting matrix of similarity coefficients was structured by a hierarchical cluster analysis.

The cluster analysis shows that inter-individual differences of movement pattern are greater than intra-individual variations. The dendrograms separate the classification groups "1", "2" and "4". The shots of athletes with classification "3" are associated to those with classification "2" or "4" and can only be separated from those with classification "1".

If the classification is considered a valid procedure, it seems that the athletes of group "3" do not have a particular shooting technique.

Further studies with a greater number of athletes are necessary for better understanding of the differences in shooting technique of the classification groups. Additional biomechanical analysis of other specific skills should be made in order to get more qualitative data for improved classification.

**Symposium****Cross Country Skiing****S114D**

S114D-1

**Physiological aspects of cross-country skiing****Holmberg Hans-Christer**

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*Keywords: VO<sub>2</sub>max, cross-country skiing, upper body*

Cross-country skiing is an endurance sport that has been of interest in physiological research through the years, not least due to the great interest in investigating the limiting factors of maximal aerobic power. Cross-country-skiers are well-known to have one of the highest aerobic powers among endurance athletes. The physiological demands are unique compared to other endurance sports as skiing involves nine different work modes in classic and free technique (4+5). The skiers are continually, in regard to inclination and character of terrain, changing work mode involving different muscles from upper, lower and upper + lower body for optimal velocity and work efficiency.

Through the years there has been a vivid discussion about the role of muscle mass for reaching the true maximal oxygen uptake in humans. Elite cross-country skiers are an exceptional group of athletes who are well trained in both upper and lower body. Combining arm and leg exercise does increase peak oxygen uptake. However, the difference is small and markedly less than could be anticipated from the sum of VO<sub>2</sub> reached when performing either lower or upper body exercise. This points to a central limitation, i.e. systemic oxygen delivery, sets an upper limit of VO<sub>2</sub>.

No other endurance sport has changed the racing disciplines as much as cross-country skiing over the last years. Increasing number of "man to man" events and the introduction of sprint discipline have in some aspects changed the physiological profile of the athletes. Several later studies show that the role of upper body strength has increased. Different training regimes designed to further

develop the athlete's ability in double-poleing have been investigated. These regimes include maximal strength training and more specific explosive-type of strength training. Physiological monitoring of cross-country skiers has traditionally been performed using running and pole-striding at a treadmill. Later special developed treadmills have made it possible to conduct more specific and standardized tests and research in both free and classical technique. Here we show that the lower body is progressively involved with increased velocity in double-poleing, previously regarded as an exclusively upper-body exercise. The use of new approaches (e.g. combining mobile oxygen consumption measurement system and GPS) will make it possible to further investigate the physiological demands of cross-country skiing in the field.

S114D-2

**Biomechanical aspects of specific imitation drills in cross-country skiing****Lindinger Stefan, Stöggl Thomas, Müller Erich**

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*Keywords: cross-country skiing, biomechanics, imitation exercises*

In modern concepts of cross-country (XC) ski racing it is generally accepted, that an increase of the quality of training is a more successful strategy for a distinct development of the XC skiing performance than an increase in the amount of training. The intensified use of highly XC skiing specific strength training devices and imitation drills in summer training must play an essential role in this strategy. Specific maximum strength, explosive strength and strength endurance are generally defined as important reserves of performance, especially in sprint disciplines. Positive effects of specific maximum strength training on endurance

performance have been shown (Hoff et al. 2002). However there is still a lack of valid training devices and imitation drills for leg and arm work.

Therefore we analysed modern skating techniques performed by world class skaters (3D-video analysis; force measurements at the sole of the feet), constructed a skating specific simulation device (leg work) and analysed it for the same biomechanical variables. A quite high correspondence and coordinative affinity to some aspects of found optimal push-off patterns in skating were shown.

A second study focused on the development of a specific strength training device for the upper body (lopsided steel rail; rolling sledge) and on the biomechanical validation of imitating double pole (kneeling position; two straps + pole grips to pull up the rail). High level national XC skiers were analysed (surface EMG - eight upper body muscles; pole and strap forces [strain gage force transducers]; elbow, hip and trunk angles [goniometers; 2D-video analysis]) during double poling and during imitation at moderate and maximum speed and constant inclinations. Both patterns show strong affinities, but also clear differences. The courses of the elbow angles indicate similar shapes, relative flexion and extension periods and angle amplitudes. The force curves and activities of certain muscles show similar characteristics. The possibility of eccentric work on the sledge (acceleration-deceleration...) in a specific situation might be an advantage for the training of maximum strength (intramuscular coordination) and strength endurance of the upper body compared to treadmills and other concepts.

Expected positive effects of imitation drills on XC skiing performance have to be proven in following studies.

Hoff J, Gran A, Helgerud J (2002). *Scand.J.Med.Sci.Sports*, 12 (5):288-95

## S114D-3

### Economy and fatigue in ski skating

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**Keywords:** cross-country skiing, energy cost, neuromuscular fatigue

Aerobic energy cost, determined by collection of expired gas, has been found to be a key factor in ski skating performance. By measuring knee/ankle joint kinematics and gastrocnemius lateralis (GL)/vastus lateralis (VL) electromyogram (EMG), it has been shown that stretch-shortening cycle (SSC) pattern occurs on flat terrain in the three main techniques of roller ski skating. In fact, an eccentric (Ecc) phase along with the existence of an EMG signal for these lower limbs extensor muscles have been observed prior to the thrust with no delay between the Ecc and the concentric (Conc) phases. For GL, the integrated EMG Ecc-to-Conc ratio and the stretching velocity increased with speed. Thus, it can be suggested that the efficiency of ski skating increased with velocity through a better use of SSC pattern in the ankle joint. Also, at submaximal velocity, significant correlations have been reported between C of roller ski skating and (i) knee angular amplitude or (ii) VL average EMG during the concentric phase. The lower average EMG during the Conc phase of the most economical skiers could be due to a greater upper body utilization and/or a greater mechanical efficiency.

A ski skating marathon alters slightly but significantly maximal voluntary strength of knee extensor muscles without affecting central activation. When comparing these results with a running race of similar duration, large differences in neuromuscular alterations can be observed despite the existence of SSC in ski skating. Differences in terms of

muscular stretching velocity and shock wave occurrence probably explain these results. Because no central fatigue was detected after skiing, it can be speculated that the lower maximal voluntary activation observed after 2-3 h of running is due to spinal modulation, possibly linked to muscular damage, rather than supra-spinal biochemical changes.

## S114D-4

### Immuno-endocrine and metabolic responses to long distance ski racing in world class cross country skiers

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**Keywords:** immune function, elite athletes, endurance exercise

Previously, we have shown that international level cross-country skiers adapt well to an acute exhaustive exercise test of shorter duration in a laboratory setting, even during periods of heavy training and multiple competitions. However, less is known about physiological disturbances during prolonged exhaustive exercise in a race setting like a World Cup competition, where the skiers often bring themselves beyond the normal limits of fatigue. The purpose of this study was to characterize the extent of immune, endocrine, substrate and metabolic changes during a long distance cross-country ski-race in extremely well trained athletes and evaluate if the blood perturbations would indicate signs of health risk. Additionally, we wanted to compare our findings with the results of similar investigations from marathon racing.

Ten male (M) and six female (F) national team skiers were investigated as they followed their usual routines of race preparations. An 8 % carbohydrate-electrolyte drink was served every 5-6 km during the race, and a mean intake of 1350 mL among the males (range 1200-1600 mL) and 800 mL among the females (range 700-900 mL) was estimated. Blood samples were drawn before and immediately (within 1 min) after the World Cup 50-km M and 30-km F ski race in Holenkollen, Oslo. Results: Mean finish time for the males was 142 min and for females 104 min. Hemoglobin, electrolytes, and C-reactive protein remained unchanged for both M and F. Serum testosterone remained unchanged in M, but doubled in F. Significant increases were observed in concentrations of granulocytes (F:5x, M:5x), natural killer (NK) cells (F:2x, M:1.5x), adrenaline (F:12x, M:10x), noradrenaline (F:7x, M:5x), growth hormone (GH) (F:30x, M:22x), cortisol (F:1.5x, M:2x), glucose (F:2x, M:1.5x), creatine kinase (F:2x, M:2x), uric acid (F:1.5x, M:1.5x), and non-organic phosphate (F:2x, M:2x), while insulin concentration decreased (F:0.5x, M: 0.8x). Free fatty acid (FFA) concentration increased (F:2x, M: 3x).

Since both blood glucose and FFA were elevated at the end of the race, no sign of major energy substrate shortage was evident. Compared to changes observed after marathon racing of similar duration, several of the blood perturbations found in this study was larger. Previous investigations have suggested that the amount of muscle mass involved in high intensity exercise may affect the degree of change in catecholamine levels. Therefore, we suggest that the substantial changes in some immuno-endocrine, substrate and metabolic variables after long distance cross-country ski racing, may reflect the large amount of muscle mass involved in this particular sport.

S114D-5

**Psychology in cross-country skiing****Hanin Yuri**

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*Keywords: emotion, skiing, group dynamics*

Cross-country skiing, especially at the Olympic level, is an extremely demanding sport, both physically and psychologically. There are four groups of factors that can enhance or impair skiing performance and these include: (a) group dynamics or social psychological factors, (b) athletes' personality traits, (c) self-regulation and coping skills, and (d) situational performance-related states in practices and races. This framework generates a wide range of practical questions, for instance, what are the optimal coach-athlete relationships and how to improve working contacts between athletes and service personnel and enhance the team's climate? What is the role of parents and parent-coaches in skiers' personal and professional development? What personality qualities are especially important in developing a world-class skier? How and why are some performance related emotions optimal whereas others are dysfunctional for skiing performance in practices and races?

From the applied perspective based on a systematic practical work with elite athletes and coaches, successful skiers need to learn at least four lessons: (a) to know how to train hard and smart (high quality training); (b) to compete successfully in races under different conditions (stress-free or using stress); (c) to perform up to their potential and succeed at the right time and in the right place; and (d) to demonstrate consistent excellence by coping with pressures of big success and performance slumps. Failure to learn and incorporate any of these four groups of skills early into one's performance repertoire might slow down or even prevent skiers' progress across their entire sports career.

This paper will examine some of these questions based on available research evidence and practical experiences of working with Olympic level cross-country skiers. The main emphasis therefore will be on the application of sport psychology to the solution of concrete practical problems encountered by Olympic level skiers. The paper will examine high quality training practices, preparation for ski-races, application of group dynamics factors, and the problems of stress and burnout in skiing coaches. Finally, future directions and implications for coaches and athletes are discussed.

*Hanin YL (Ed.) (2000). Emotions in Sport, Champaign, IL: Human Kinetics*

**Oral Session****Training and Testing 3: Diagnostics****O114E**

O114E-1

**Notational analysis in tennis as a talent identification tool - single case study****Unierzyski Piotr**

University School of Physical Education, Poland

*Keywords: tennis, notation analysis, junior athletes*

The ability to connect tactical decisions and shot precision into one process is an important factor affecting performance in modern tennis. Therefore assessing this ability already at the junior age should be useful in a talent identification process. To verify this hypothesis a retrospective notational analysis of a match played by two junior players was undertaken. The aim of the research was to compare the statistics taken during a match of two junior players with two matches played by worlds' top professional players.

Match statistic of two under 14-year-old tennis players was undertaken. These players went to top spots on ITF Junior Ranking 4 years after the video was taken. Now they are very close to get into top 100 on ATP professional ranking. The statistics from 'junior' match were compared with data taken during two quarterfinal matches of Roland Garros in 1999. For the purpose of notational analysis each half of the tennis court was divided into 16 equal rectangles. Four rectangles located in the middle of the court formatted 'middle' zone, 12 other quadrates, located close to side and base lines formed external zone. In order to assess serve precision each service box was divided into 3 zones (internal, middle, external). Beside traditional match statistics stroke precision (i.e. technical quality) was assessed through the percentage of shots placed in external and internal zones of service box (when assessing the serve) and external zone of the court (when assessing all other strokes).

The results show that general picture of the junior match did not differ significantly from two professional matches. Also the technical quality of the junior players was very high. Professional players were serving more often into external

service zones than juniors; this tactics give more chance to 'open' the court with the next shot.

Minor differences were reasoned by natural physical advantage of much older players. The research showed that young players were able to learn technical and tactical skill already at the early age and that they might be one of the reasons of their fast progress. These observations suggest that measuring technical quality in a match situation might be useful as a predictor of future performance level and a tool in talent identification procedures. It is also advised to the coaches to integrate shot precision practise into technical training.

*Schönborn R. (1999). Advanced techniques for competitive tennis; Unierzyski P, Osinski W (1998) Czynniki determinujące poziom sportowy w tenisie - AWF Poznan.*

O114E-2

**Diagnostic of motor skills and metabolism for talent promotion in soccer****Spitzenpfeil Peter, Lorenz Rudolf, Hartmann Ulrich, Jeschke Dieter, Bauer Gerhard**

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*Keywords: soccer, motor control, exercise physiology*

For talent identification and promotion in soccer as in most other sports beside the extent of physical fitness specific motor skills are very important for the performance. Traditionally diagnostics in soccer mainly focus on endurance capacities and on simple speed tests as 10m-, 20m- or 30m-sprints (Coen et al. 1998; Muecke et al. 1993). As speed in its different extensions is proposed to be an important skill in soccer it seems to be necessary to create a differentiated diagnose setup for this field. The only multidisciplinary approach is published by Reilly et al. (2000).

In the context of a talent promotion project of the TU Munich with the junior-team of FC Bayern Munich three tests for exercise physiology and nine for motor control were made to identify strengths and weaknesses of whole teams and individual players. The aim of the presented study is to discuss the relevance of a differentiated and multidisciplinary diagnostic in soccer. Therefore results of the mentioned tests from 2001 and 2002 were analysed to get the development of the whole sample, teams and of individuals.

The results of the metabolic tests did not show any mean differences between the three tested teams (U21, U19, U17). Also no correlations were found between aerobic parameters and motor tests. Correlations were found between the anaerobic values from the bicycle test and the results in the "20m sprint" and "shuttle run".

For the absolute values of nearly all (exc. "flash jump", "match6") different tests for motor control significant (sig.) correlations to the age of the players (r of abs. values) could be found in 2002. As expected this indicates that there is an increase of performance by (training) age.

As there is only one and even negative ("shuttle run") correlation between age and the percentile values (r of %-values) it can be assumed, that the tested sample behaves like the comparison group. Therefore the sig. mean differences ("0-10m", "10-20m", "match4") of the ANOVA of paired samples from 2001 to 2002 (mean diff. 02-01 of %-values) show real improvement in this tested skills. Looking at the single teams nearly all (exc. U21) increased performance in the "0-10m" test.

It can be concluded that a multidisciplinary and differentiated approach is necessary to get detailed information about strengths and weaknesses of whole teams and of individual players in soccer.

#### O114E-3

### Diagnostic of relevant elementary performance prerequisites in basic training of female sports gymnasts

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*Keywords: gymnastics, basic training, measurement units*

Analysis of current tendencies in sports gymnastic development shows an important increase of demands in power as well as movement speed. The reasons are the continuous progress in degree of difficulty in this kind of sport. For prognostic abilities it is necessary to emphasize methodical feature already in youth training.

We conceived three measurement units to check power abilities of young sports gymnasts. They are deduced from units of other kind of sports and from the specially requirement in sport gymnastic. 1) drop jump exercise: with a contact mat and a connected software program heights and floor contact times after a drop jump will be captured. It serves to make a statement about realized time programs or the capacity of taking off of young gymnasts in a very early training stadium. Powerful take offs are basis to reach very big heights in acrobatic elements. 2) rope pulling ergo meter: ability to change powerful the angle of arms and body which determines the size of angular velocity of the whole body and thereby the starting angular momentum for very difficult flight elements and dismounts on uneven bars. This generated momentum is of prime importance for the reachable flight height. During a cyclic retaken, movement for closing or opening arms and body angle relevant physical important parameters like maximum velocity will be determined. 3) skateboard: to perform vault exercises or acrobatic elements

on floor, strength and contact time of push off from arms and shoulder joints are very important. The higher the momentum the bigger the flight height. With help of a special conceived measurements unit this movement course will be simulated. Contact time, push off velocity and the covered distance are being recorded. Measurement units were conceived to diagnose relevant elementary performance prerequisites, specially movement speed abilities. The investigations are carried out with female gymnasts in basic training.

#### O114E-4

### Importance of cyclic drive in swimming

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*Keywords: swimming, cyclic drive, stroke parameter*

Two partial performance features determine performance in swimming. The result of swimming competition is made up of time for start and turns and time for cyclic movement. The split times almost amount to 1/3 respectively 2/3 of the finish time. We investigated into the impact of partial amount of cyclic movement on the result and the possibility to optimise the cyclic drive by varying moving frequency and stroke length and/ or a variation of velocity-time curve. Our investigation is based on competition analyses of all finals during XXVI. European Championships in Swimming 2002 in Berlin.

The following parameters were calculated: velocity [m/s], frequency [1/min], stroke length [m], stroke index (SI, mod. Costill) and power index (PI=SI/t). The swimmers were divided into three groups (finalists; semi-final winners; semi-final losers). Mean values and standard deviation were calculated for these groups. Paired and unpaired t-test were used for inter-group comparisons.

Finalists showed a high reproduction of performance. There were no significant differences in finish time between finals and semi-finals. The results of semi-final losers were 2 - 5 % lower. 20 to 30 % of these time differences were related to start and turns and almost 2/3 of the time to the cyclic movement. In all styles stroke length was increasing the longer swimming distance is up to 200 m. In events longer than 200 m stroke length in freestyle events decreased again. For constant velocity there was a hyperbolic relation between moving frequency and stroke length. Driving energy during each stroke varied in relation to swimming distance and the individual level of performance. Especially in freestyle swimming the stroke index is continuously increased with increasing swimming velocity. We found a similar behaviour for the backstroke swimming. The increase in stroke index was much lower respectively constant in breaststroke and butterfly swimming. We demonstrated the essential influence of partial amount of cyclic movement on the results.

It amounts to 2/3 of the time differences. Stroke length is closely related to the anaerobic energy expenditure. There are differences in the structure of cyclic movement between alternating and simultaneous swimming styles. Increasing speed is caused by a higher driving energy during each stroke in alternating styles. In simultaneous styles an increase in frequency dominates. Consequences for training are discussed.

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Nomura T, Shimoyama Y (2002). *IXth Word Sym Biom and Medicine in Swimming, Book of Abstracts*, 127

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O114E-5

**Factors dissuading the pursuit of an elite career in track and field****Enoksen Eystein**Norwegian University of Physical Education and Sport,  
Norway*Keywords: talent, dropout, elite career*

This research project is based upon data from a longitudinal quantitative survey of talented Norwegian track and field athletes (N=300), and qualitative retrospective depth-interviews of 24 elite performers. The study started in 1975 and was finished in 2000. The purpose of the interviews was to identify factors contributing to the process of skill acquisition and training practices in the different developmental phases to become elite track and field performers. In the longitudinal study focus was on drop-out problems in competitive athletics. The main reasons for withdrawal from track and field competitions were injuries, lack of motivation and conflicts with other interests/activities. The interview data show the important role of "significant others" - especially the personal coaches - in enhancing athletic potential in young talented track and field athletes. The study also underlines the need for a better motivational climate, and the training facilities and procedures at critical periods. It also reveals a relatively high frequency of injuries among young talented track and field athletes and the need for more systematic medical care and therapeutic procedures.

to attain the required standards of competition are such that if more than 72 hours are needed to recover from training stress, the training process can be considered to have failed. It is therefore imperative to identify maladaptation to training as early as possible. 'Prevention - by careful monitoring seems the most effective approach' (Shephard, 2001). Unfortunately, according to Urhausen and Kindermann (2002) 'there has been little improvement in recent years in the tools available for diagnosis' (of overtraining syndrome). The maintenance of a regular training log, with components suitable for the detection of overtraining, might be the only method of preventing overtraining available to athletes without regular access to physiological, biochemical and immunological testing (Fry et al., 1991). The potential use of the athlete's training diary as the first line of defence against early overtraining, therefore deserves investigation. This study examined the capability of such a training diary to predict impending performance decrement, using binary logistic regression analysis.

The subjects were 13 National Squad 'Olympic distance' triathletes who maintained compliance within a previously described prospective training diary study (Vleck et al., 2002) for 21 weeks. The training status indicators that were used as covariates for analysis were composite derived values for resting morning heart rate, delayed onset muscle soreness, appetite, sleep quality, viral illness, and factor scores for the Profile of Mood States-C (Terry et al., 1995). All such training status indicators were individual specific and took the athlete's response on occasions of peak performance into account.

Performance decrement was highly correlated with the combination of composite derived scores for delayed onset muscle soreness within the same week ( $P < 0.00$ ), composite appetite score for the previous week ( $P < 0.05$ ), confusion score for both one week ( $p < 0.03$ ) and two ( $p < 0.001$ ) weeks prior, plus anger in the previous week ( $p < 0.05$ ). The prediction rate for performance decrement of the training diary system was 89.4 %. Given that the training diary is the most freely available and commonly used method of feedback in triathletes, its use as a means of warning of impending maladaptation should be further explored.

O114E-6

**Prediction of impending performance decrement in national squad triathletes: use of the athlete's training diary****Vleck Veronica, Grubb Howard, Bentley David J, Gallagher Sean, Cochrane Tom**

University of Greenwich, England

*Keywords: training diaries, prediction, performance decrement*

Kentta and Hassmen (1998) state that the amount of sessions that elite athletes (irrespective of sport) need to do

**Symposium****Control of Gas Exchange during Exercise****S114F**

S114F-1

**Control of oxygen uptake****Barstow Tom**

Kansas State University, United States

*Keywords: respiration, oxygen uptake, oxidative phosphorylation*

Measurement of oxygen uptake at the lungs ( $\dot{V}O_2$ ) has been used for more than 100 years to estimate whole-body metabolic rate, both under resting conditions and during a variety of physical activities including formal exercise. Since the stores of oxygen in the body are small,  $\dot{V}O_2$  can reflect, both in the steady state and during transitions between different metabolic rates, the sum total of oxidative phosphorylation throughout the body. Following the onset of exercise or an increase in power output, muscle oxygen

uptake ( $\dot{m}V\dot{O}_2$ ) begins to increase in an apparent exponential fashion towards an asymptotic, or steady state level, which at least up to near peak  $\dot{V}O_2$  conditions is set by the power output.

One of the most fascinating questions in exercise biology has been how mitochondrial oxidative phosphorylation is precisely coupled to the rate of ATP usage by the contracting myocyte across a wide range of ATP turnover rates. The apparent mono-exponential nature of the time course of adjustment of  $\dot{m}V\dot{O}_2$  and, after a circulatory lag,  $\dot{p}V\dot{O}_2$ , for moderate exercise intensities has suggested a simple, linear control system with one rate-limiting step or component in this domain of exercise intensity.

Most data suggests that this rate-limiting step is located intracellularly, as  $O_2$  delivery by the circulation appears in excess of the muscle uptake. However, despite intense investigation from the level of the whole-body down to

individual myocytes and to isolated mitochondria, the precise location or nature of this limiting site remains controversial. When more intense contractions are evoked, the behavior of  $\dot{V}O_2$ , at least of whole muscles ( $m\dot{V}O_2$ ) and/or the whole body ( $p\dot{V}O_2$ ), become more complex. If the exercise is sustained for more than 2-3 minutes, a second, additional, progressive increase in the  $\dot{V}O_2$  signal is noted. While the precise location of this additional  $\dot{V}O_2$ , termed the "slow component", remains incompletely defined, it appears to be confined to the exercising limb(s), and may be related to changes in motor unit recruitment patterns within the contracting muscle, or to recruitment of additional muscles.

Control of  $m\dot{V}O_2$  in this domain of heavy or severe exercise intensities thus becomes more complex than a simple linear system. Additionally,  $O_2$  delivery by the circulation may begin to limit the  $m\dot{V}O_2$  response either in the steady state or in the transition, which would elicit further non-linear metabolic responses by the affected myocytes.

### S114F-2

#### Control of carbon dioxide output

**Whipp Brian**

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**Keywords:** *lactate threshold, respiratory compensation, CO<sub>2</sub> stores*

CO<sub>2</sub> production ( $\dot{V}CO_2$ ) during square-wave exercise reflects  $O_2$  consumption ( $\dot{V}O_2$ ) and the substrate mixture being catabolised. For moderate exercise (< lactate threshold, LT),  $\dot{V}CO_2$  is therefore monoexponential with a time constant ( $\tau$ ) similar to  $\tau_{\dot{V}O_2}$ .  $\dot{V}CO_2$  is subsequently expressed at the lung ( $\dot{V}CO_2$ ), following the muscle-lung vascular transit, with a longer  $\tau$  reflecting the influence of the high capacitance CO<sub>2</sub> stores as a result of: transient alkalosis caused by H<sup>+</sup> trapping during phosphocreatine hydrolysis, and increased muscle and muscle venous PCO<sub>2</sub> which increase [bicarbonate] (HCO<sub>3</sub><sup>-</sup>). This capacitance effect is evident also during ramp exercise, largely in the early phase during which  $\dot{V}O_2$  decreases. With high incrementation rates and/or prior stores depletion by volitional or anticipatory hyperventilation, this effect can obviate valid non-invasive estimation of LT; a false positive (pseudo-threshold) ensuing. Above LT,  $\dot{V}CO_2$  kinetics is more complex, reflecting: (a) translation of the non-linear  $\dot{V}O_2$  slow component into a corresponding  $\dot{V}CO_2$  response; (b) production of supplemental CO<sub>2</sub> from the falling muscle and blood [HCO<sub>3</sub><sup>-</sup>] consequent to metabolic H<sup>+</sup> buffering; and (c) the kinetics of compensatory hyperventilation for the metabolic acidemia. For heavy exercise (WRs at which elevated arterial [lactate] and [H<sup>+</sup>] can be stabilized),  $\dot{V}CO_2$  often transiently overshoots. This reflects a rapid phase of CO<sub>2</sub> stores washout consequent to rapidly-falling [HCO<sub>3</sub><sup>-</sup>], but with little early recruitment of compensatory hyperventilation (PaCO<sub>2</sub> and PETCO<sub>2</sub> not yet declining). Despite augmented peripheral chemoreceptor stimulation at these WRs, PaCO<sub>2</sub> is slightly elevated in the on-transient (suggesting slow respiratory compensation kinetics, relative to PCR responsiveness). At higher WRs (for which [lactate] and [H<sup>+</sup>] increase throughout the work to the tolerable limit),  $\dot{V}CO_2$  kinetics revert to monoexponential, but slower than < LT. No  $\dot{V}CO_2$  "slow phase" is evident, despite being discernible in  $\dot{V}O_2$ . This steady-state-like behavior of  $\dot{V}CO_2$  is associated with a progressive increase in VE and a decline in PETCO<sub>2</sub> related to the compensatory hyperventilation. In conclusion, supra-threshold  $\dot{V}CO_2$  kinetics is not consistently monoexponential, but even when so, they should not be considered reflective of simple-compartment dynamics.

Rather, the  $\dot{V}CO_2$  time constant conflates the influences of the differing rates of HCO<sub>3</sub><sup>-</sup> breakdown and degrees of compensatory hyperventilation with the underlying aerobic component.

### S114F-3

#### Control of ventilation

**Ward Susan**

University of Leeds, United Kingdom

**Keywords:** *lactate threshold, redundancy, chemoreceptors*

Below the lactate threshold (LT), ventilation (VE) correlates closely with pulmonary CO<sub>2</sub> output ( $\dot{V}CO_2$ ), effecting stability of arterial PCO<sub>2</sub> and pH. At work rates associated with a metabolic acidemia (above LT), VE dynamics become nonlinear and steady states may not be attained: VE increases out of proportion to  $\dot{V}CO_2$ , with the resulting hypocapnia constraining the pH fall (respiratory compensation). Models of ventilatory control during exercise have traditionally invoked chemosensory proportional feedback and neurogenic feedforward control. The rapid VE increase at exercise onset is thought to be neurally mediated ("central command" and/or muscle reflexogenic drives), although cardiocirculatory drives responsive to changes in central circulatory pressures and intramuscular vascular conductance and/or tissue pressure have also been proposed. The control of the subsequent and predominant mono-exponential phase 2 component has traditionally been thought to be humoral, providing the necessary "fine tuning" for arterial blood gas and acid-base regulation. This may involve the peripheral chemoreceptors (PCRs) and possibly also CNS short-term potentiation. Above LT, the PCRs are largely responsible for mediating the respiratory compensation for the lactic acidosis. Interestingly, the ventilatory control system appears to demonstrate considerable redundancy, selective inactivation of individual putative pathways having little impact on the control outcome. This has motivated the formulation of innovative control models that reflect not only spatial interactions but also temporal interactions; e.g. optimisation of humoral and respiratory-mechanical ventilatory "costs"; long-term potentiation or memory. In conclusion, the challenge is therefore to discriminate between robust competing control models that (a) integrate such processes within plausible physiological equivalents and (b) account for both dynamic and steady-state system responses over a range of exercise intensities.

### S114F-4

#### Ventilatory and gas exchange coupling during exercise: The challenge of impaired systemic function

**Haouzi Philippe**

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**Keywords:** *exercise hyperpnea, pulmonary gas exchange, patients*

The study of the relationship between ventilation and pulmonary gas exchange response to dynamic exercise in patients presenting altered gas exchange kinetics or having lost important afferent mechanisms of the respiratory neurones in the medulla has provided crucial information for our understanding of the mechanisms coupling ventilation to pulmonary gas exchange ( $\dot{V}O_2$ ,  $\dot{V}CO_2$ ).

This review summarises some of the information gained in these patients. Two questions are addressed, namely how exercise hypernea is regulated in these pathological conditions in relation to the change in metabolic rate, and which structures are critically important for the close link between ventilation and pulmonary gas exchange observed in normal subjects?

1- The study of patients with a right to left cardiac shunt, with severe peripheral vascular disease of the lower extremities and with de-afferented heart and lung has shown that the VE response to exercise can be dissociated from the gas exchange rate at lung level and that operative cardiac or lung receptors are not a prerequisite for a normal isocapnic VE response to exercise. 2- Investigation in patients who lack CO<sub>2</sub> sensitivity showed that an intact chemoreceptive mechanism is not essential for an appropriate ventilatory response at least during moderate exercise. 3- Ventilation

increases during electrically induced muscle contraction in paraplegic patients, without spinal transmitted afferent information from skeletal muscles, but with a very long kinetics, suggesting a possible chemical error signal in the arterial blood. 4- An important role during heavy exercise for blood borne factors such as lactate or K<sup>+</sup> can be dismissed from the VE response of patients under hemodialysis or with muscular glycogenosis.

All these data suggest a fundamental ability of the respiratory control mechanisms to adapt to pathological condition in order to maintain blood gas homeostasis. A normal matching between VE and gas exchange during exercise appears to be independent of one isolated factor such as receptors located in the heart, the lung, the existence of CO<sub>2</sub> sensitivity, or spinal transmitted afferent information.

## Symposium

### Computer Science in Elite Sport

**S114G**

#### S114G-1

#### Application of neural networks to analyze performance in sports

**Perl Jürgen, Baca Arnold**

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*Keywords: modelling, neural networks, Kohonen network*

The so called Kohonen Feature Map is a type of Neural Network, which - after a phase of training - is able to recognize complex information structures, which are called patterns. In terms of sport such patterns e.g. can be processes or situations/states in games or movements. In the learning phase, similar patterns are identified and combined to clusters, which then form a low-dimensional representation of the high-dimensional set of the original patterns. In the productive phase of recognition, the network identifies a given pattern as a member of the associated - i.e. most similar - cluster.

Examples from table tennis and rowing shall demonstrate the applicability of these methods.

Table tennis: A model has been developed for a process oriented description of the table tennis match. Using this model, a game process can be understood as a time-series of high-dimensional patterns, which describe the situations at each point in time. The problem, however, is that the lot of recorded information - which of course is necessary for analyses of details - in turn might prevent the recognition of typical technical or tactical structures. A network-based analysis reduces the amount of information without losing its specific contents and so can help to better recognize common structures and striking features.

Rowing: The performance of four athletes of different level on a rowing ergometer has been analyzed. Different biomechanical parameters have been recorded. Again, the process can be understood as a time-series of high-dimensional patterns, which now are described by kinematic and kinetic parameters. Inter- and intra-individual analyses make sense in order to recognize e.g. similarity between and stability within processes. For this purpose the structures of processes can be visualized using trajectories, which connect consecutive situation patterns to time-dependent sequences.

The presented method can be used as well for qualitative analyses, as for deeper quantitative analyses. So, in the case of table-tennis, the qualitative analysis can help to

identify types of players and visually detect opponent-invariant components in the respective tactical structures, while the quantitative analysis can measure differences, similarities and stabilities of tactical patterns on the basis of reduced and condensed data. In the case of rowing, the trajectories additionally give information about the time-dependency of the process and so e.g. allow for recognizing weak points in the movement.

#### S114G-2

#### Computer science in support of top level game sports

**Lames Martin**

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*Keywords: game analysis, game sports, realtime position analysis*

Technological development is a rigid pace-maker for progress in computer science in sport. The early beginnings in the seventies were marked by struggles with technology to ensure only basic services by computer science. Solving these problems gradually gave the opportunity to focus on methodological considerations or theoretical aspects of the procedures. In our days technological development has reached a level which allows intense support for top level sports, especially for team sports.

Computer Science and Game Sports. The performance in game sports can be understood as the result of specific interactions between the opponents. That means in turn that performance is less determined by players prerequisites (skills and abilities), but emerges during the interaction process. Therefore, the analysis of behaviour in competition is of paramount importance. The support of game analysis by computer science comprehends image processing, observational systems and multi-media features. Recent developments in video processing on computers have led to fully digital solutions for game analysis systems. Current interests in game analysis are in the area of an appropriate modelling of performance in game sports, and to support practice by detailed analysis of tactical behaviour of the own team or the next opponent.

Although there is promising benefit, communication technology has not yet been fully exploited for the support of top level game sports. Only recently projects are designed to

replace the face-to-face service with local information processing by internet-based communication. A central analysis station provides teams or players all around the world with computer science services. If projects show the feasibility and utility of these services, which will never achieve the level of face-to-face interactions, this will be an interesting application of computer science in sports. Many game sports enroll in "world cups", "world series" or "world tours" with events all around the year and all around the globe. At present the costs of a continuous service with information from game analysis prevents regular services in many of these sports.

Real-time position analysis is a promising solution for a still persistent problem, the time needed to analyse graphical information. Although one should distinguish between the technological solution and a solution for practical problems – mere position information solves no problem at all – one can be optimistic that progress in game analysis created by technological dynamics is going to continue.

### S114G-3

#### The role of virtual reality in sport and human performance

**Katz Larry, Levy Richard, Chang Ernie, Kopp Gail, Chisamore Chris**

The University of Calgary, Canada

*Keywords: sport performance, elite sport, virtual reality*

Virtual Reality (VR) or Effective Virtual Environments (EVE) for training in sports and human performance can be powerful, compelling, transparent, and engaging tools for improving existing skills and for learning new behaviors. Individual athletes can practice different situations safely, and work with coaches and team members collaboratively over distance. The technology currently exists for the creation of innovative, immersive, interactive 3D environments. At the University of Calgary, researchers in Kinesiology, Environmental Design, Education, Medicine, Engineering, Computer Science, and Psychology are working together to develop effective virtual environments that focus on motion and cognition to help in both skill enhancement and decision-making. Elite performance is a major focus of the EVE initiative, and the University of Calgary, with its Olympic Oval, is well positioned to facilitate this endeavor. The Olympic Oval programs ([www.oval.ucalgary.ca](http://www.oval.ucalgary.ca)) host numerous high performance athletes and elite level sports teams who are eager to collaborate with University researchers. With EVE, athletes can be put into virtual environments where multiple-sensory information can be applied. Re-enacting peak performances, analyzing modeled techniques or reviewing personal performances from multi-angled 3D views, can be undertaken in an interactive, immersive virtual world. To date, there has been very little research into the effectiveness of VR environments with elite athletes. This

presentation will provide an overview of the research initiatives currently under way at the University of Calgary, and provide a brief examination of what VR might offer elite athletes in terms of improved competitiveness and training, and the potential for future development of VR technologies. If these virtual worlds are truly effective, then the modeling and simulation of complex situations should provide athletes with the edge needed to achieve their maximum performance.

### S114G-4

#### Emergence of play in team sports games

**Pavicic Leo**

University of Zagreb, Croatia

*Keywords: team sport game, play, emergence*

Team sports game (e.g.: soccer, basketball, water polo, and handball) as a competition of two collectives is defined as a dynamic complex system consisting of a number of emergent levels or layers.

In order to enable formalization, "granule" is introduced as a comprehensive expression suggesting required level of abstraction. Team sport games are, in that context, defined as a set of granules. Relations between parts/behaviors or granules within layers are defined by rules. Granule and rules identification and enumeration, for given team sport game, can be most appropriately established by using bottom-up approach where description of the game is used as a source of information. In dynamic complex systems emergence is a phenomenon that is not aggregative, i.e., not predictable from the full knowledge of its components, and not decomposable to those components. In this paper, play is considered as uppermost emergent layer of a game. However, it is not always present, which is also the case with other layers. It occurs only in games, or parts of the game, when sufficient amount of diversity of team behavior is attained. In the last ten years, phenomenon of emergence becomes one of the core concepts of computational modeling of dynamic complex system in computer science, including artificial intelligence/life, and multi agent systems. Hence, it is suggested that computer simulation is most appropriate scientific tool for team sports game modeling. In addition possible tools for modeling are shortly discussed.

Soar/SDML (Strictly Declarative Modeling Language) package which enables building of sophisticated simulations involving agents, multi-agents, and, complex organizations, and, Swarm which is used in simulation of collections of concurrently interacting agents. For useful intuitive examples of modeling and theory we can also look elsewhere, in the scientific fields with longer tradition in using this approach, e.g.: sociology, biology, organizational theory, philosophy of mind – cognitive science, and robotics (BBS, MAS, RoboCup).

## Symposium

### New Developments in Sports Nutrition 2

S114H

S114H-1

#### Nutrition supplements: Risks versus benefits

Maughan Ron

Loughborough University, England

No Abstract

## Oral Session

### Biomechanics 8

O114I

O114I-1

#### Object recognition in digital sports video

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*Keywords: object recognition, video*

Several methods have been developed to track objects in sports. In the field of 3D kinematic analysis systems, mainly marker-based methods are used to track human joints. Human motion analysis also receives increasing attention from computer vision researchers. Here objects are being tracked using a wide range of methods, such as in video surveillance or in human computer interaction. In these cases and in sport competition marker-based methods are useless. However, automated capturing, analysing and quantifying of human or object motion can offer significant help to sports experts. It assembles various pieces of information about the sport activity right during the action and can help the audiences to better appreciate the sport, if this information is presented in real-time or with only a short delay. So, the aim of this study is the development of a tracking system without markers for use in sports.

Professional video software offers methods for tracking objects. Similar to 3D kinematic analysis systems, they are mainly marker-based. In sport competition events and mass media reporting only fast marker-less algorithms are useful. Such systems offer the possibility to analyse athletes without any manipulation or preparation. These algorithms can easily be integrated into specialized analysis systems for individual use.

A possible field is the production of software for mass media to demonstrate or visualize interesting movements of subjects or objects. Here, the algorithms must be fast and the workflow as short as possible. Sports science and sport experts often use specialized or self-made analysis systems, so that they can integrate these tracking algorithms into their systems. This study demonstrates the real possibility of tracking objects marker-less in real-time or near real-time. Depending on the method of image acquisition, the applied algorithms can work automatically, but in reality slight manual corrections are often necessary.

O114I-2

#### New method for 3D kinematic analysis in skiing

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*Keywords: 3D kinematics, skiing, movement analysis*

Full 3D movement reconstruction requires at least 3 markers in sight of at least 2 cameras for each segment. In alpine skiing field studies are essential for high quality analysis. However, it is difficult to fulfil the demand mentioned above, because of the large range of motion in skiing. Therefore it is necessary to develop a method in which the amount of markers is reduced and a full 3D movement reconstruction can still be carried out. The purpose of this study is to introduce a new method for a 3D kinematic analysis in skiing and to evaluate it with the conventional method in a ski-type movement.

The basis of this analysis is the definition of a plane through the hip, a marker on the thigh and one on the calf during the complete movement. The position of the hip is calculated according to Klous & Van Soest (2002) using the 3D-coordinates of at least 3 markers of the trunk and one marker on the thigh. This step makes the hip a spherical joint. The plane through the hip and the two markers mentioned above, defines the orientation of the knee and effectively turns it into a hinge joint. I.e. the rotational axis of the knee is the axis perpendicular to this plane. The full 3D movement reconstruction of a segment requires the definition of a local coordinate system (LCS) for each segment at each instant of time. One of the axes for the LCS of the thigh is the rotational axis of the knee (y-axis). The other axis is the vector from the marker on the thigh to the hip (z-axis). The third axis is the vector perpendicular to the other two axes (x-axis). The marker on the thigh can be used as origin of this LCS to complete the definition. Since the position and orientation of the thigh is now fully reconstructed, the same technique as used for the hip can be used to determine the position of the knee. Another LCS can be defined for the calf in the same way as for the thigh. All segments now have a full 3D reconstruction of their motion. To evaluate the accuracy of the new method a laboratory experiment was carried out and a comparison to a conventional 3D kinematic analysis for a chain of segments was made, described by Klous & Van Soest (2002).

The resulting velocities of the hip for both methods are almost equal. Comparing the resulting velocity of the hip, calculated for both methods, a difference of 0.04 m/s found.

The difference found between the two methods seems to be acceptable when inaccuracies during the experiment, like skin movement artefacts are taken into account. Similar results have been found for the calculated knee joint.

#### O114I-3

### Isometric trunk extension testing with different intensity on the corresponding changes of the EMG signal

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**Keywords:** EMG, muscle fatigue, testing

Changes of EMG signals, in the frequency and time domain, are generally used to quantify muscular fatigue. The MedPF of the EMG power spectrum is sensitive to early physiological manifestations of muscle. Endurance time as an indicator for muscular resistance to fatigue is a common and easily measurable parameter in daily performance testing, whereas the comparison of results (endurance time) obtained from different tests is rather difficult due to different testing positions and intensities.

Based on these considerations, the purpose of this study was to compare four different intensity levels when testing muscle fatigue and to investigate the effect of the testing position (vertical or horizontal trunk) on the EMG signal.

Five healthy male subjects took part in this preliminary study. They performed four muscle fatigue tests with different intensity for the back extensors. During the fatigue test the subjects had to hold their intensity until complete exhaustion. Surface EMG signals were recorded bilaterally from the erector spinae muscles at TH12 and L3 (Biovision, 1000Hz). From each muscle the MedPF [Hz] of the power spectrum was calculated continuously. ANOVA with repeated measurements and were used to identify significant differences of MedPF, slope MedPF and muscle site ( $p < 0,05$ ).

The average endurance time  $t_{es}$  was significantly different between all intensity levels except between level II and III. Focusing on the different intensity levels, we found higher MedPF during the first 50% of  $t_{es}$  in level IV compared to the levels I, II and III.

The slope of the MedPF was markedly steeper (slope 10%-90% and slope 10%-50%) for level IV compared to all other levels.

Focusing on the muscle site (L3ri, L3le, TH12ri, TH12le), we found no differences in MedPF for the discreet timespots of  $t_{es}$ . But the MedPF slopes (10%-90%, 10%-50% and 50%-90%) were significantly steeper for L3ri+le as for TH12ri+le. No differences between the right (L3ri, TH12ri) and the left (L3le, TH12le) muscles sites were found.

The testing position (vertical or horizontal trunk) has a marked impact on the content of the EMG signal. The initial MedPF is considerably higher in all observed muscle sites when working against gravity (horizontal position), which is due to a different recruiting and frequenzing pattern in this testing position. So the activity of the observed muscle sites is much higher despite the surprisingly high endurance time compared to the intensity levels I, II and III. Thus the endurance time does not reflect the muscle fatigue in different testing positions.

#### O114I-4

### Validity and reliability of different strength parameters measured by MVC

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**Keywords:** maximal voluntary contraction, speed strength

Maximum voluntary contraction is commonly used to determine (1) maximum strength ( $F_{max}$ ), (2) explosive strength (maximum rate of force development (MRFD); Schmidbleicher, 1992), (3) contraction speed (initial rate of force development (IRFD); Schmidbleicher, 1992), and (4) speed strength (ratio of maximum force and contraction time ( $F_{max} \cdot t_{max-1}$ ); Satsiorsky, 1995). In this context it is quite unclear, whether these four parameters can be measured reliably by the MVC-method, and whether they are valid in regard to dynamic measures of maximum strength and speed strength.

The different strength abilities were investigated in 48 male and 35 female student athletes of different sports. In the study, the four different parameters were measured with a MVC of the arm extensors when the participants performed the test bench press. Dynamic maximum strength of the arm extensors was tested by the 1-repetition-maximum (1-RM) in the bench press test, and dynamic speed strength was determined by the maximum power output ( $P_{max}$ ) when performing the bench press with 20 percent of the load of the 1-repetition-maximum. Initial and maximum rates of force development, isometric maximum strength (and the time needed to achieve it), and dynamic speed strength could be measured reliably.

Besides that, some of the different parameters showed only a limited validity in regard to dynamic maximum and speed strength.

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#### O114I-5

### Anthropometrical analysis by 3D body scanning - an application for clinical and sports-scientific investigation

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**Keywords:** anthropometry, body scanning, ski-jumping

Anthropometry is a central method in biomechanics, but most anthropometrical studies still base on manual measurements. Now the 3D body scanner opens the possibility to carry out objective and economic investigation by a touch-less, three-dimensional catch of surfaces of human beings. The short scanning-time even allows the processing of surveys. This high-resolution scan serves the purpose of creating a virtual, digital twin of the scanned object, so that various anthropometrical parameters can be seen and quantified.

The 3D body scanner (VITRONIC GmbH) catches all bodies up to a height of 2.1m and a diameter of 1.2m with a resolution of 1.0mm in depth, 2.0mm vertically and 1.0mm horizontally. Technically the scanner bases on a modular system with four columns. Two CCD-cameras and a laser are integrated in each column. The measurement method is an optical triangulation. With software (HUMANSOLUTION

GmbH) as digital tape measure for extensive anthropometrical 3D-editing, new methods for clinical and biomechanical investigations are established.

In clinical applications the Scanner is used for the diagnosis of postural characteristics. There the qualitative analysis is facilitated by a visualisation in all planes. The quantitative analysis can objectify qualitative results by interactive measuring of anthropometrical parameters.

A sport scientific project in ski jumping is the control of rule conformity of the jumpers suits, to compare the manual tape measurement with our measurement system and to develop a more objective control-system. At the Skijumping-WorldCup 2001 in Hinterzarten (Germany), anthropometry of  $n=66$  athletes had been tested. For each ski jumper two scans were analysed (with the jumping suit and wearing underwear) to check the difference. In contrast to the manual test our results couldn't confirm rule-conformity in all cases. So we proposed some enhancements to improve this inspection. Therefore new criterias could be the frontal surface, the total body-surface or the volumina summed up of several parts of the body.

3D body scanning is a valuable method for imaging and quantifying anthropometric measurements. However, for the daily use in the clinical processing of surveys reliability must be controlled by further studies. The ski jumping project showed that 3D body scanning influences positively the objectivity of competition control. By using individual anthropometric instead of absolute criteria for competition control the equality of opportunity would be increased.

O114I-6

### A motion analysis during the performance test of professional cyclists

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*Keywords: cycling, performance diagnostics, motion analysis*

Performance tests are an integral component of assessment for competitive cyclist in practical and research tests. They

are tests based on physiological measures. The specific question of our analysis is to combine the physiological and motional measures during increasing power.

The study population consisted of nine male professional cyclists. The age was  $25.8 \pm 5.6$  years; the height  $180.3 \pm 5.9$  centimetres, the weight  $70.8 \pm 5.9$  kilograms, the oxygen consumption  $70.2 \pm 7.2$  ml/min/kg and the fat percent  $13.2 \pm 1.8$ . Each cyclist was examined during the common performance test. The lactate amount of the capillary-blood was determined before the exercise, after all loading steps and 5 minutes after finishing the exercise. The ZEBRIS ultrasound measuring system with a 19-point biomechanical model was used for determining the spatial coordinates of important antropometrical points of lower extremities. The surface EMG electrodes were attached to m. vastus medialis, m. biceps femoris, m. gluteus maximus and m. gastrocnemius medialis. The registered action potential of each electrode enables representing the muscles activity.

The critical loading-step for the anaerobe threshold of each cyclist was determined from lactate amount of the capillary-blood. The flexion-extension motion is characterized by the knee's angle-time function calculated from the spatial coordinates of anatomical points. The muscle-activity is characterized by EMG envelope-curve in time-function.

The analysis and comparison of the different result indicated that the movement and the muscle-activity are disordered close to the anaerobe threshold. Thereafter both the movement and the muscle activity become ordered, however the characteristic of the curves differs from the curves in the aerobe stage. The muscle activity increases closely linearly with the loading, except the activity of m. gastrocnemius med which does not depend on the power rate.

The motion analysis completed by physiological tests gives a complex analysis of the physiological and motional behaviours of professional athletes.

## Oral Session

### Biomechanics 9: Muscle Strength

O114J

O114J-1

### Isokinetic knee strength related to vertical jumping performance in elite handball players

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*Keywords: handball, vertical jump, isokinetic strength*

The ability of athletes' neuromuscular system to produce peak isokinetic torque in relation to vertical jumping performance (VJP) is a criterion characterizing quite a few sports, handball being one of them. The purpose of this study was to bring out certain elements of correlation, due to knee movement, between muscular strength and team handball players' VJP, which, in turn, should influence competitive performance.

Fifteen elite, Greek National Team handball players age, mean (S.D): 24.6 (3.7) years, weight: 91.1 (10.0) kg and height: 188.7 (7.5) cm participated in this study. A Cybex II+

Isokinetic Dynamometer measured the subjects' Left and Right knee extension (EX) and flexion (FL) strength. Testing was conducted at angular velocities of 0.52 rad/s (Low), 2.09 rad/s (Moderate) and 4.19 rad/s (High). GRF data were acquired by the use of a force platform (Type 9281 B11 Kistler-250 Hz). Subjects executed the following tests: With Arm Jump (WAJ), Counter-Movement Jump (CMJ), Squat Jump (SJ) and Continuous (repetitive) Vertical Jumps (CVJ) for 60s, of which we present results of the 1st and the 15th effort. Statistical Analysis was performed using one-way ANOVA between both knees, concerning in differences angular velocities and correlations were derived between isokinetic peak torque/body weight (T/BW) and Vertical Jumping Height (Pearson, r).

Significant difference only annuenced between the isokinetic strength in left and right knee extension at high angular velocity,  $P < 0.05$ . The subjects' VJP in the WAJ test, considerably over-dominated the other tests ( $P < 0.000$ ). From the correlation analysis between isokinetic characteristics and those of VJP, results show that, the strength of L-knee flexors evaluated at all three angular velocities, correlates with the

VJP (except the SJ test), something which does not happen with the strength of R-Knee flexors. More specifically, R-Knee extensors at moderate angular velocity have important correlation with the performance in four of the VJH. Important relationship among L-Knee flexors strength R-Knee extensors strength and jumping performance characteristics, especially at moderate velocity, was found.

This element emphasizes even more to optimize muscular coordination of the L-Knee impulse, which is used by the majority of handball players for execution of jumping movements. According to these casual significant relations, Left and Right knee extensors-flexors strengthening is recommended for high-level handball players aiming in improving VJP.

#### O114J-2

### Isokinetic parameters of handball players shoulder horizontal adductors and abductors

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*Keywords: handball, shoulder, isokinetics*

Horizontal adduction movement is a part of ball throwing of handball players, but the shoulder isokinetic parameters in this movement are not investigated in wide scale. The aim of our investigation was to compare the isokinetic parameters of the shoulder horizontal adductors and abductors of handball players.

The shoulder joint motions in horizontal adduction - abduction were investigated using dynamometers system "REV - 9000" Technogym. 18 male handball players participated in the investigation. All shoulder joints were injury - free. The subject position was supine on the test table. The elbow was maximally extended. The horizontal adduction - abduction movements were performed in the horizontal plane. The range of movements was from 20° of the shoulder horizontal adduction to 100° of the abduction. The chest and pelvis were stabilized using straps. The shoulder horizontal adduction and abduction isokinetic movements were tested at slow angular velocity of movement 60°/s and medium movement 90°/s. The peak torque, time from beginning of movement to reach the peak torque, isokinetic part of the movement duration, average work and average power were determined for every muscles group. Then the shoulder muscles produced torque values were determined in the ROM with 10° steps.

All determined isokinetic parameters did not differ significantly in the dominant and non-dominant arms horizontal adductors and abductors, respectively. The torques at the different angular positions of the ROM did not differ significantly between the dominant and non-dominant arms at slow angular velocity 60°/s for the shoulder horizontal adductors and abductors, respectively. At the medium velocity of movement 90°/s the torques produced by the shoulder horizontal adductors of the dominant and non-dominant arms differed significantly ( $p < 0,03$ ) at the angular position of the ROM 80° - in the beginning of the horizontal adduction movement (more specific for handball activities), in the other angular positions the torques of the dominant and non-dominant arms did not differed significantly. The torques of the shoulder horizontal abductors did not differ significantly between the dominant and non-dominant arms at the velocity 90°/s.

#### O114J-3

### Changes in explosive strength (RFD) of agonist and antagonist muscles at the knee joint in female handball players after acute muscle fatigue

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*Keywords: muscle strength, muscle fatigue, knee joint stabilisation*

The present study introduces a Hamstring/Quadriceps strength ratio based on maximal contractile rate of force development (RFD). The rationale for this 'explosive' strength ratio is based on the notion, that the ability to rapidly reach a given level of antagonist-agonist muscle force in fast and explosive movements may have important implications for the capacity to provide adequate muscular knee joint stabilization, hence protecting the ACL from serious injury.

In the present study, seven female handball players were tested for absolute and normalized RFD, and RFD H/Q ratio prior to and after a standardized simulated handball match was performed in the Lab (50 minutes). RFD was determined during maximal isometric quadriceps and hamstring contraction exerted in an isokinetic dynamometer (KinCom). RFD was derived as the average slope of the moment-time curve in fixed time intervals (0-30, 0-50, 0-100, 0-200 ms) and when normalized to MVC (at 1/6, 1/2 and 2/3 MVC).

After the simulated match procedure, hamstring and quadriceps MVC decreased by 10.0% and 20.2%, respectively ( $p < 0.05$ ). Relative RFD H/Q ratio approached unity (1.0) only at 2/3 MVC indicating a relative deficit in hamstring RFD in the initial contraction phase (0-100 ms). After the simulated match procedure, relative RFD H/Q ratio decreased at 2/3 MVC ( $p = 0.06$ ).

The decrease in relative RFD H/Q ratio may reflect a reduced potential for muscular knee joint stabilization. When fast and explosive knee joint movements are initiated, the quadriceps was able to reach 2/3 MVC significantly faster when fatigued. Since no change in relative RFD was observed for the hamstrings, this finding could indicate a muscular strength disorder and corresponding risk of ACL injury if motor programs to initiate fast and explosive knee joint movements are not adjusted accordingly. In conclusion, the present data underline the importance of appropriate motor programme adjustments to compensate for the differential changes in relative agonist and antagonist muscle RFD induced by muscle fatigue during the time course of a handball match.

#### O114J-4

### Maximal torque, EMG and activation level during eccentric, concentric and isometric actions

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*Keywords: eccentric contraction, maximal torque, activation level*

Maximal isometric force is usually lower than the eccentric one measured at the corresponding joint angle (e.g. Komi 1973). There are also some opposite results, mainly with knee extensors, in which the isometric force has exceeded the eccentric one (Linnamo et al 2002). This could be due to neural inhibition that has been suggested to occur during



maximal eccentric action (Westing et al. 1990). The present study examined whether this possible inhibition would also occur in maximal plantar flexions with the triceps surae muscle group.

Subjects performed maximal eccentric and concentric plantar flexions with the triceps surae muscle group. Maximal and passive efforts were also performed with a supramaximal double twitch in each condition to assess the activation level. Surface EMG was recorded from the soleus and medial gastrocnemius muscles.

Maximal torque was lower ( $P<.001$ ) in concentric than in eccentric and isometric actions while no significant differences were observed between eccentric and isometric actions. Maximal torque prior to electrical stimulation was somewhat lower (N.S) than in pure voluntary condition. No significant changes were observed in EMG or in AL between different conditions.

After isometric preactivation the force immediately after the stretch exceeds the force at the pre-stretched level (e.g Edman et al 1978). In the present study the maximal eccentric torque was only slightly higher than the isometric one. This suggests that possible inhibition during maximal eccentric action, previously observed with knee extensors (Linnaamo et al. 2002), may take place also in the triceps surae muscle group. Although maximal EMG of the soleus muscle was lowest in eccentric action the results of the activation level did not support the concept of inhibition. The activation level during the dynamic actions may have, however, been affected by the change in the joint angle and muscle length. Torque values were somewhat higher performed without electrical stimulation. Thus anticipation of pain may also have affected the measurements.

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#### O114J-5

### Reducing the strain of the working muscles by momentarily increasing the work load

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**Keywords:** workload

In epidemiological studies, repetitive work and cold have both been identified to be risk factors in the development of musculoskeletal disorders. One possible mechanism inducing these disorders could be the "Cinderella" effect, meaning that in low intensity stereotypic activation of muscle same low-threshold motor units are the first ones to be recruited, and that these units are active throughout the contraction. The use of the same fibers throughout the work may result in premature fatigue and this, in the long run, may lead to overuse symptoms and injuries. Increasing occasionally and momentarily work intensity thus utilizing different fibers could possibly alter the monotonous recruitment of the same low-threshold fibers. The aim of this study was to evaluate if momentarily increasing workload reduces the overall strain of the muscles during repetitive work in cold.

Eight subjects performed six 20 minute repetitive work bouts (120 minute exposure) at 5 °C twice. The work during the

first exposure consisted of wrist flexion - extension work at 10 %MVC (reference), contraction every third second. During the second exposure to 5 °C every tenth contraction was performed at 30 %MVC level (10+30, thirty second intervals). During the exposures the local skin temperature, average EMG activity (aEMG) and physiological gaps (PG) of the wrist flexors were measured.

The results showed that there were no differences in the local skin temperature between the conditions. At 10+30 condition the aEMG activity of the wrist flexors decreased by 10 % ( $p<0.01$ ) and the amount of physiological gaps increased by 56 % ( $p<0.01$ ) as compared to reference condition.

The results indicate that during repetitive work in cold occasionally increasing work intensity decreases aEMG and increases the amount of physiological gaps. As the temperature of the overlying skin of the working muscles remains the same throughout the work this refers to the fact that variation in fibre recruitment takes place. This could decrease the susceptibility for overuse symptoms and injuries and in the long run for musculoskeletal disorders.

#### O114J-6

### The alteration of agonist and antagonist calf muscle activation during and after a fatiguing submaximal isometric contraction, in adult and pre-pubertal females

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**Keywords:** EMG, fatigue, age

The purpose of the present study was to investigate the alteration of torque and EMG activity of agonist and antagonist calf muscles during and after submaximal sustained contraction among adult and pre-pubertal females.

Fifteen untrained women (age:22,2±1,4 yrs, body mass:59,6±6,2 kg, height:165,7±7,9 cm, means±SD) and fifteen untrained girls (age:9,8±0,9 yrs, body mass:38,0±9,9 kg, height:140,1±6,5 cm, means±SD) subjects volunteered to participate in this study, with informed consent. Before fatigue protocol, all the participants performed several maximum voluntary contractions (MVC) for the plantar flexors and for the dorsi flexors, on a Cybex Norm dynamometer. Electromyographic (EMG) activity from Soleus (SOL) and Tibialis Anterior (TA) muscles was recorded by bipolar surface electrodes. After MVC testing, fatigue was induced by a 10 minutes plantar flexion at 20% of MVC. Immediately after the fatigue protocol and then for five times every three minutes, the participants performed one MVC for the plantar flexors. All torque and EMG values were normalized relatively to the MVC measurements before the fatigue protocol. Analysis of variance for repeated measurements was used for the statistics analysis of data.

All subjects showed a significant decrease in the torque output after the fatigue protocol. The Tukey post hoc tests showed that women were less fatigued than girls, but girls had a faster recovery up to 2nd trial of MVC ( $p<0,05$ ; Fig.1). The agonist and antagonistic EMG activity increased gradually, during the fatigue protocol. As far as SOL activity is concerned, girls showed significant higher values than women, between 7-10 minutes of fatigue protocol ( $p<0,05$ ; Fig.2). During the recovery phase, girls still had higher values than woman until 3rd trial of MVC. Concerning TA EMG the girls showed significant higher values than women at last two minutes of fatigue protocol. In recovery session, there were no statistical differences.

These findings suggest that the fatigue in MVC of plantar flexors during submaximal fatigue protocol between women and girls could be attributed in central and neuronal factors (Fuglevand et al., 1993; Pasquet et al., 2000).

*Fuglevand A et al (1993). J Appl Physiol 60: 549-572*

*Pasquet B et al (2000). Muscle Nerve 23: 1727 - 1735*

## Plenary Session

### Physical Activity and Exercise and their Effect on Chronic Disease and Impairments

PL12H

#### PL12H-1

##### Can exercise help cure chronic disease?

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*Keywords: rehabilitation, sarcopenia, patients*

Skeletal muscle plays a role both by training induced metabolic changes that will influence oxidative capacities, membrane constitution and fuel combustion of importance for development and severity of disease, but also by acting as a force producing unit that ensures daily physical activity level and function. It is important to distinguish between 1) diseases in which regular exercise will have a primary impact on the pathogenesis of the disease and thus improve the pattern and severity of the disease. Examples of such diseases are type-2 diabetes, ischaemic heart disease, hypertension or muscular-skeletal dysfunction (sarcopenia and osteoporosis). 2) diseases that will not in itself be influenced by the training but where physical training will not make the disease more severe and where training like in healthy people will positively influence risk factors for development. In addition to this, training will improve overall daily function, and thus often cause reduced complaints over deficits in patients. In addition, some patients score an improved mental well-being and status in association with the onset of training. Such examples are chronic lung disease, most kidney diseases, type-1 diabetes, cancer and osteoarthritis/rheumatoid arthritis. Finally, there are 3) diseases where exercise is relatively contraindicated, and where uncontrolled exercise will worsen disease. Examples on that are generalized infectious diseases, aorta stenosis and several arrhythmia conditions. What to train and how often? The discussion must concentrate on an accurate description of whether a) central cardiovascular oxygen transporting capacity is trained ("aerobic/cardiovascular fitness") by loading the heart through endurance activities with large muscle groups e.g. running, whether b) muscle are loaded repeatedly with low resistance activity (e.g. long walks) and thus the oxidative capacity of the muscle tissue is improved through rising the mitochondrial oxidation capacity ("metabolic fitness"), or whether c) skeletal muscles are loaded against high resistance over only a few repetitions to perform resistance training and achieve increased muscle strength, muscle hypertrophy and "functional fitness". In addition to these elements, also coordination and balance training contributes positively to the functional outcome of the patient training.

#### PL12H-2

##### Challenging limits and expectations: sport and athletes with a disability

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*Keywords: adapted physical activity, disability sport, sport sociology*

As a social institution and a microcosm of society, sport has been, and will continue to be, influenced by the political, social, and cultural changes in society. Sport has been discussed as a site for the struggle for access, equity and social justice among various social identity groups. Athletes with a disability represent the most recent group of persons to have sought for access to and equity in sport.

Disability sport has evolved and has been acknowledged in, and by, the sporting world. Athletes with a disability have access to sport opportunity and as a consequence, sport (disability sport) has been changed. What are the barriers to participation and the limits placed on individuals with a disability? How has the presence of athletes with a disability changed perceptions of disability? Has our view of sport changed? Is disability sport (sport) a site for social justice?

The purpose of this presentation is to provide a socio-cultural perspective of athletes with a disability, their challenges and expectations for inclusion in sport, and ways in which disability sport assists with societal change.

## Symposium

## Exercise and Cardiorespiratory Disease

S121A

## S121A-1

## Exercise and cardiorespiratory disease

Dickhuth Hans-Hermann

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*Keywords: physical activity, cardiorespiratory disease, cardiovascular mortality*

The importance and effects of physical activity concerning primary and secondary prevention, as well as rehabilitation has been the subject of wide-spread epidemiological studies and scientific research over the last few years. Aside from the influence of other classical risk factors, different results are well documented in the literature.

There is an inverse relationship between physical activity and performance, as well as between physical activity and cardiovascular mortality. The difference between additional physical activity and physical performance is important, since performance is determined to a large degree by genetics, whereas the level of activity only slightly influences performance.

Neuro-humoral activation, particularly autonomous regulation, that is reduced parasympathetic activity on the one hand and increased sympathetic activity on the other, shows a positive relationship to cardiovascular mortality. This is particularly true for existing cardiovascular diseases with initial or existing cardiac insufficiency. Limited performance and autonomous dysregulation are also caused by changes in peripheral muscles, and can, in part, be traced back to training or exercise.

Accordingly, peripheral muscular training condition or exercise condition influences the cardiovascular system to a greater extent than was previously assumed. However, the relationships still have not been established with certainty, and, in addition, various mechanisms are being discussed. It is presumed that an extended stress reaction model plays an important role in this. Knowledge of physiologically acute and chronic stress reactions to training or exercise, therefore, is important to understand physical activity in prevention and existing heart disease.

Altogether, this supports the interpretation that mainly changes to the vegetative nervous system through dynamic training leads to improved cardiovascular mortality for healthy people, as well as for heart patients.

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## S121A-2

## Exercise in rehabilitation in chronic obstructive lung disease

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*Keywords: exercise, training, lung disease*

In contrast to the established role of exercise training in cardiac rehabilitation, physical activity in rehabilitation of chronic lung disease is less common, at least in Germany. However, several studies within the last years clearly demonstrated that regular physical activity in chronic obstructive lung disease improves respiratory gas exchange, muscle function of respiratory tract and limbs. Improvement is also observed for walking distance and, partly, for quality of life. In contrast, static and dynamic lung function parameters remain fairly unchanged, this holds true for vital capacity, FEV 1.0 etc. Studies with arm exercise yielded divergent results. Mostly improvement of ventilatory muscle endurance could be demonstrated. Some of the studies are small sized, large scale studies are needed to confirm preliminary findings. For patients with chronic asthma, especially younger patients, physical activity is an established approach improving function and quality of life. There are some recommendations on in- and exclusion criteria, and examinations needed before participation.

So far, physical activity is one of the basic approaches for treatment of chronic lung disease, besides avoiding influences of noxes and drug treatment.

## S121A-3

## Strength training in chronic cardiovascular disease

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*Keywords: health, resistance strength training, cardiac diseases*

Though aerobic activities have become an integral part of cardiorespiratory rehabilitation, attitude to resistance exercise is still rather cautious. The main concern is an augmented cardiovascular risk due to pronounced blood pressure response to strength exercise. However, evidences accumulated over the last decade have shown that blood pressure reaches potentially dangerous values only if large muscle groups are activated to lift weights close to 1RM under involvement of Valsalva manoeuvre. On the other hand, blood pressure during resistance exercise performed with moderate weights (up to 70 % of 1RM) does not substantially exceed the values occurring during common forms of aerobic exercise. Though there is slightly more pronounced increase in diastolic pressure, this may be considered as a positive response. As blood supply of heart muscle only takes place when its tension drops below the values in aorta, i.e. during diastole, higher diastolic pressure in fact fosters coronary perfusion. Also general recommendation to avoid Valsalva manoeuvre due to its potentiation of blood pressure has been questioned. If

applied only for a short period of time, so that no serious impairment of venous blood return occurs, higher intrathoracic pressure may actually enhance systolic contraction applying concordant "outside" force to ventricular walls. In addition, higher intrathoracic pressure, transmitted through spinal nerve foramina into the cerebrospinal fluid reduces the mechanical stress on artery walls due to increased blood pressure. Regular resistance training performed at moderate intensities, i.e. with weight around 70 % of 1RM not only increases strength and power, but affects positively also lean body mass, resting metabolic rate, bone mineral density, insulin resistance, local oxygen extraction and proprioceptive functions. These adaptation changes can positively affect the overall state of a patient with chronic cardiovascular disease. In conclusion, resistance exercise is a reasonably safe and effective means, which can potentiate health promoting effect of aerobic activities not only in healthy subjects, but also in patients with chronic cardiac disease.

#### S121A-4

### Exercise and hypertension

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*Keywords: exercise, blood pressure, hypertension*

Several large epidemiological studies which allowed for age and anthropometric characteristics have reported an inverse relationship between blood pressure and either habitual physical activity assessed by questionnaire or interview or

measured physical fitness. In addition, exercise and fitness were inversely related to the later development of hypertension. It remains difficult, however, to ascribe these findings to physical activity or fitness because of possibly interfering confounding factors.

Therefore well-controlled intervention studies with random allocation to exercise or control are mandatory to further explore the relationship between exercise and blood pressure. For a meta-analysis we identified 68 study groups from 44 trials involving 2,674 participants. The changes of blood pressure in response to dynamic physical training, after adjustment for the control observations ranged from + 9 to - 20 mm Hg for systolic blood pressure and from + 11 to - 11 mm Hg for diastolic pressure. The overall net changes averaged - 3.4/- 2.4 mm Hg ( $P < 0.001$ ). Peak oxygen uptake had increased by 12% and heart rate was reduced by 7%. The mean determinant of the blood pressure response was baseline blood pressure. The training induced weighted net changes of blood pressure averaged - 7.4/- 5.8 mm Hg in the hypertensives and - 2.6/- 1.8 mm Hg in the normotensives. The blood pressure response was not different according to age or body mass index. Significant reductions of blood pressure have also been shown for blood pressure measured during exercise testing or during 24-h ambulatory monitoring, particularly during the day.

Physical activity and dynamic exercise may therefore contribute to the prevention of hypertension and to the management of the hypertensive patient. The extent of the pretraining evaluation will mainly depend on the intensity of the envisaged exercise and on the patient's symptoms, signs, overall cardiovascular risk and associated clinical conditions.

## Oral Session

### Physiology 7

#### O121B

#### O121B-1

### Physiological background of fractal heart rate dynamics

**Tulppo Mikko, Kallio Mika, Hautala Arto, Kiviniemi Antti, Pietarila Paavo, Seppänen Tapio, Huikuri Heikki**

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*Keywords: heart rate variability, muscle sympathetic nervous activity, fractal analysis methods*

Reciprocal changes in autonomic regulation caused by dynamic exercise and passive head-up tilt test increases fractal scaling properties of heart rate (HR) dynamics. However, decreased fractal scaling properties are observed in various cardiac diseases. The physiological background for decreased fractal behavior of HR is not well known. We tested the hypothesis that the breakdown of fractal behavior of HR occurs during the concomitant sympathetic and vagal activation.

A short-term fractal scaling exponent ( $\alpha-1$ ) of HR dynamics, analyzed by detrended fluctuation analysis method, and a high frequency spectral components of HR variability (0.15-0.4 Hz) along with muscle sympathetic nervous activity (MSNA) from peroneus nerve were analyzed at rest and during a sympathetic stimulation by hand grip (3 min, 25 % of maximal voluntary contraction) and during a concomitant sympathetic and vagal activation caused by cold face immersion (0°, 2 min) in healthy subjects ( $n=6$ ).

The mean HR increased from  $61 \pm 6$  to  $65 \pm 10$  (bpm,  $p < 0.05$ ) during the hand grip and decreased during the cold face immersion from  $60 \pm 7$  to  $57 \pm 6$  (bpm,  $p < 0.05$ ). MSNA

increased during the hand grip from  $20 \pm 12$  to  $24 \pm 11$  (bursts/min,  $p < 0.05$ ) and during the cold face immersion from  $19 \pm 10$  to  $26 \pm 8$  (bursts/min,  $p < 0.05$ ) as an evidence of increased sympathetic activation during both interventions. The high frequency power of RR intervals increased from  $6.78 \pm 1.37$  to  $7.45 \pm 1.31$  (ln ms<sup>2</sup>,  $p < 0.001$ ) during the cold face immersion as an evidence of increased vagal activation and did not change during the hand grip  $6.59 \pm 1.22$  to  $6.58 \pm 1.08$  (ln ms<sup>2</sup>). The mean value of  $\alpha-1$  increased from  $0.84 \pm 0.24$  to  $1.01 \pm 0.37$  ( $p < 0.05$ ) during the hand grip and decreased from  $0.96 \pm 0.32$  to  $0.81 \pm 0.37$  ( $p < 0.05$ ) during the cold face immersion.

Physiological interventions affecting the sympatho-vagal interactions result in divergent changes in fractal correlation properties. A breakdown of fractal HR behavior is observed during the co-activation of vagal outflow at the time of increased sympathetic activity.

## O121B-2

**Morphological and functional differences in cardiac parameters between power and endurance athletes: a magnetic resonance imaging study**

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*Keywords: MRI, hypertrophy*

No unambiguous determination of the divergent cardiac adaptation was presented so far. The present study was made to compare the morphological and functional parameters of the left ventricle measured by magnetic resonance imaging (MRI) between competitive athletes engaged in endurance and power activities and sedentary control subjects.

Twenty male subjects were studied by MRI including 7 endurance-trained athletes (ETA), 7 strength-trained athletes (STA), and 6 sedentary controls.

In the ETA group the relative left ventricular mass was significantly higher than that of the STA group, and the difference between their relative left ventricular wall thickness values was near to the level of significance chosen ( $p = 0.057$ ). The relative LVID were measured significantly higher in the ETA group according to the STA group. Significantly higher relative SV was determined in the ETA group compared to the STA group and the controls.

According to our hypothesis, the strongest impact on LV cavity size and wall thickness is caused by long-term high intensity endurance training. The intensive strength training is not necessarily incidental to wall-thickening.

## O121B-3

**Bimodal relationship between the heart rate and high-frequency oscillation of heart rate in athletes**

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*Keywords: heart rate*

High-frequency (HF) spectral power of RR intervals is a widely used tool to study vagal modulation of heart rate. However, a pharmacological modulation of autonomic tone suggested dissociation between vagal activity and HF power of RR intervals at the heart rate levels below ~ 50 bpm. Athletes' heart rate can be markedly below 50 bpm and therefore the analysis of vagal activity based on heart rate variability may be biased e.g. at resting conditions. We tested the hypothesis that the HF oscillation of RR intervals do not increase despite the further lengthening of RR intervals at the heart rate levels below ~ 50 bpm.

24-hour ambulatory RR intervals were recorded for 18 athletes during a non-exercise day. Six athletes were excluded from further analysis due to the changes in P-wave morphology. Finally, 12 subjects were included in the study (22±4 years, 4 female, 8 male). The mean RR intervals and the HF power of RR interval variability (0.15-0.4 Hz) were analyzed in 5-min sequences over a 24-hour RR interval recordings. The HF power values were plotted as a function of the corresponding mean RR interval values. Linear and quadratic models of regression analysis were used to study the relationship between the RR interval length and HF power values. Inflection point of quadratic model (RR0) was calculated for each case. If RR0 was between observed

minimum and maximum RR interval values the relationship between RR interval and HF power was defined as strongly quadratic.

The relationship between mean RR interval length and corresponding HF power were strongly quadratic for 8 subjects (5 males and 3 females) and linear for 4 subjects. There were no significant differences between the groups in average heart rate or any heart rate variability indices over 24-hour recordings (e.g. heart rate = 60±8 vs. 63±11 bpm, and HF-power = 7.56±0.86 vs. 7.24±0.72 ms<sup>2</sup>, for quadratic and linear group respectively). The average RR0 was 1322±239 ms for the strongly quadratic group.

Quadratic relationship between RR interval and HF power of heart rate variability was detected in most cases among athletes. This finding may well explain a conflicting result in studies where heart rate variability has been used to assess cardiac vagal regulation in athletes.

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## O121B-4

**Heart rate variability (HRV) as a method for aerobic power estimation in athletes during interval hypoxic-hypercapnic training (IHHT)**

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*Keywords: heart rate variability, interval hypoxic-hypercapnic training, aerobic capability*

Improvement of competitive performance in athletes is based on efficient adaptation of cardiovascular and respiratory systems. Under the influence of IHHT the complex of biochemical changes occur: enhancement of reactive oxygen species and endogenous oxygen fluctuations and activation of the prooxidation-antioxidation reactions. Free radical behavior of such changes under the IHHT influences demands, using effective non-invasive monitoring to control and correct the evolving tendencies.

We studied 8 athletes (long-distance runners and triathletes). The training regimens of IHHT (from 3 to 5 settings during 1 session, 4-6 times per week) were modified individually using Frolov's hypoxicator. The duration of the training period was 1-3 months, depending on athletes' biochemical reactivity. The functional state and IHHT efficiency were determined weekly by HRV method with orthostatic probe.

The initial functional state of the athletes was approximately similar: 1) in supine position TP-2000-3500 ms<sup>2</sup>; VLF-35-55%; LF-20-45%; HF-25-45%; 2) in standing position marked decrease of TP and high sympathetic activity. According to the training effects of IHHT, athletes were divided into two groups: A - with middle reactivity (4 persons); B - with high reactivity (4 persons). The A group was characterized by approximately twofold increase in TP, and mild increase in vagal tone in supine position, while the B group showed up to fourfold increase in TP and more effective sinus bradyarrhythmia. Interestingly, in the B group VLF decreased significantly with 5-14% with simultaneous increase in HF with 65-75%. The changes in spectral parameters of HRV during orthostatic probe showed positive tendency in both groups. But only in group B TP was higher or equal to that in supine position, and HF was significantly higher than in group A. The high variability of the rhythmogram after the training is accompanied by lower level of HR and peculiar image of scattergram. Such situation reflects efficient reciprocation of different levels of regulation: from mitochondrial and to vegetative.

Controlled stimulation of free radical reactions by means of IHHT influences could actively provide oxygen and energy capability. Effective participation of aerobic metabolism in maintenance of pO<sub>2</sub>, pCO<sub>2</sub> and pH of blood is the base to optimize cardio-respiratory function and to enhance resistance against oxidative stress. Systematic control of labile HRV parameters changes gives reliable information about current state of individuals' aerobic metabolism in extreme conditions.

#### O121B-5

### **Aerobic endurance training in patients with intermittent claudication: effects of high and low intensity training**

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**Keywords:** *intermittent claudication, high intensity training, VO<sub>2</sub>peak*

Physical training is known to be an effective treatment for peripheral arterial occlusive disease (PAOD) patients. The purpose of this study was to determine the exercise intensity which is most effective in an endurance treatment for PAOD patients. The aim was further to address mechanisms associated with improvement in physical performance.

Effects of 8 weeks of supervised endurance training 3 times a week were examined in 16 patients with intermittent claudication. The patients were randomly assigned to two groups. The two groups performed physical training at intensities corresponding to 60% and 80% of their peak oxygen consumption, respectively. Peak oxygen consumption, work economy, time to exhaustion, blood flow, 1-repetition maximum, heart rate, lactate concentration in blood, oxygen saturation in blood, self-perceived experience of exhaustion, and ankle-brachial index were measured before and after the training period.

A significant ( $p < 0.05$ ) larger improvement for the high intensity group was observed as a difference between groups in peak oxygen consumption (9%) and time to exhaustion (16%).

In PAOD patients, high intensity training led to better improvements in physical performance than low intensity training. Since no significant differences were observed in work economy, blood flow, 1-repetition maximum, peak heart rate, oxygen saturation, and ankle-brachial index, it is likely that the groups' different response to exercise was related to the mitochondrial oxidative capacity of the claudicating muscles and not to circulatory changes.

#### O121B-6

### **Acute neuromuscular changes during heavy resistance fatiguing loading before and after strength training in older women with fibromyalgia**

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**Keywords:** *fatigue, strength training, fibromyalgia*

Systematic strength training (ST) increases muscle strength characteristics contributing to an improvement in functional capacity. Intensive and/or voluminous heavy resistance (HR) loading in healthy subjects has been shown to lead to remarkable acute decreases in force production characteristics and voluntary neural activation of the loaded muscles. Less is known about acute effects of exhausting HR loading in patients with musculoskeletal diseases. The purpose of this study was to investigate acute neuromuscular changes during HR loading before and after the 21-week ST period in older women with fibromyalgia (FM) in comparison to those in healthy age-matched controls.

Thirteen women with FM (FMW; 60±2 yrs) and eleven healthy women (HW; 65±3 yrs) performed HR loading before (wk 0) and after (wk 21) the ST period of 21 wks. ST was performed twice a week using progressively increasing loads of 40-80 % of 1RM. The HR loading consisted of the bilateral leg press exercise (5 sets with 10 repetitions). Before the loading and after every set maximal isometric bilateral leg extension force, explosive force in 500 ms (EF), and integrated EMG activity of the right and left vastus lateralis (VL) and medialis (VM) muscles were recorded. Blood samples for the determination of blood lactate were taken before, after the 3rd and immediately after the last set, and after resting for 15 min and 30 min.

HR loading at wk 0 and 21 led to significant decreases in maximal forces and EF and increases in blood lactate in both groups. No significant changes were observed in the maximum average EMG-activity of the right and left VM+VL muscles. ST for 21 wks improved maximal force and the average EMG-activity of the right and left VM+VL muscles significantly in both groups. The acute changes in maximal force, EF, and EMG-activity during HR loading at wk 0 and 21 did not differ between the groups. The present study showed that neuromuscular functions improved both in HW and FMW during ST. HR loading in both groups was similarly fatiguing before and after ST. However, the absolute force levels throughout the actual fatiguing loading remained in both groups higher at wk 21 than at wk 0.

The data suggest that the present HR loading was associated with similar acute neuromuscular responses and that the trainability of the neuromuscular system over the 21-wk training period was also similar in women with FM compared age-matched healthy females.

## Oral Session

### Health and Fitness 4: Health Related Physical Fitness

O121C

#### O121C-1

##### The effect of a preventive balance board training program

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*Keywords: ankle injury, balance board, prevention*

In a wide variety of sports the most common location of injury is the ankle. A preventive measure that is believed to be as effective as external ankle support systems and that is without unwanted side-effects, is proprioceptive balance board training. A prospective trial on the clinical effect of proprioceptive balance board training was carried out during the 2001-2002 volleyball season in the 2nd and 3rd national volleyball divisions in the Netherlands. The aim of this study was to investigate the clinical effect of proprioceptive balance board on the incidence of acute ankle injuries in volleyball.

Teams were randomly divided in an intervention group (66 teams, 628 players) and a control group (52 teams, 494 players). Intervention teams were instructed to follow a prescribed balance board training program as part of their warming-up. Control teams followed their normal training routine. At baseline all participants completed a questionnaire on demographic variables, sports participation, history of injury, and preventive measures used. This questionnaire was repeated halfway and at the end of the measurement season. Coaches of all participating teams reported training and game exposure, as well as injuries on a weekly basis.

Results showed an acute ankle injury incidence in the intervention group of 0.5 per 1000 player hours, whereas that of the control group was 0.9 per 1000 player hours. A Cox regression analysis with adjustments for gender, age, player function and previous ankle sprains showed that the risk rate of ankle sprains was lower in the intervention group (RR=0.5,  $P<0.01$ , 95% CI 0.3 – 0.9). A subgroup analysis for players with previous ankle sprains also showed a lower risk of ankle sprains in the intervention group (RR=0.4,  $P<0.01$ , 95% CI 0.2 – 0.8). No difference was observed for players without previous ankle sprains.

A preventive effect of the balance board training program was only found for players with previous ankle sprains. This might suggest that, since a previous ankle sprain is an important risk factor for a recurrence, we are not looking at a preventive effect of the balance board training program, but at a rehabilitative effect. A proprioceptive balance board training program integrated in the normal training routine is therefore recommendable for all players who sustain an ankle sprain.

#### O121C-2

##### Comparison of risk factors for coronary heart disease in a sample of the rural and urban populations of Tanzania, with special reference to the level of physical activity

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*Keywords: physical activity, risk factors, coronary risk factors*

To estimate and compare risk factors for coronary heart diseases in the rural and urban populations of Tanzania, with particular reference to the level of physical activity.

A total of 501 rural and 484 urban women and men aged 30-60 years took part in a population-based cross-sectional investigation. Anthropometrical measures, blood pressure, serum lipids, as well as the level of physical activity were determined for each participant.

A lower prevalence of coronary heart disease (CHD) risk factors was noted in the rural than in the urban area, for women and men. The rural population had a significantly higher physical activity level (PAL) than the urban population, ( $29.8 \pm 15.8$  against  $16.5 \pm 8.6$  kcal/kg/d). High blood pressure was found in 17% of the rural and 29% of the urban populations. Overweight (obesity) was found in 17 % (10%) of the rural population, against 41% (34%) in the urban population. Prevalence of central obesity was significantly lower in the rural than in the urban populations (49% vs. 74%). The rural population had slightly lower values of TC, TG, HDL-c, LDL-c and TC/HDL-c. PAL was inversely associated with most of the selected risk factors as well as a significant negative predictor.

It is suggested that urbanization is accompanied by an unfavourable alteration of several coronary risk factors. Although the levels of some selected coronary risk factors in the sample of the Tanzanian population were low compared to those reported from studies conducted in western communities, the observed urban-rural differences might be indicative of a progress towards an increase in CHD in Tanzania, as a result of increased urbanization and associated lifestyle alterations.

#### O121C-3

##### Leisure physical activity and health related physical fitness: A randomised trial from 4 public schools in Portugal

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*Keywords: physical activity, health, prepubescent children*

Regular physical activity is linked to enhance health, reduced risk for all-cause mortality and the development of many chronic diseases in adults. Children and adolescents have more physical activity than adults, but the participation in physical activity declines in adolescence.

To know the current situation and relationship of physical activity and health-related physical fitness on school-based children in Portugal.



During the spring of year 2002, a sample of 131 boys and 133 girls 10-15 years old children were randomly selected from 4 public schools in 4 different regions of Portugal. FITNESSGRAM and questionnaire were selected to investigate children's health-related physical fitness and physical activity.

Results show that more than 80% of the children failed to meet all minimum standards in FITNESSGRAM that can be regarded as physical fit; more than a quarter of children suffer from overweight and about 7% students suffer from obesity by comparing their BMI with the standard of International Obesity Task Force. Nearly 70% of the children watching TV more than two hours and a quarter of them even more than 4 hours per school day. Less than half of them engage in moderate to vigorous physical activity on a regular basis. About one fifth of them do not do any exercise in their leisure time. Girls are significantly less active than boys. Our study also shows that children who regularly participate in moderate to vigorous physical activity had a moderate correlation with children's physical fitness ( $r=0.30$ ,  $p<0.001$ ) and cardiovascular fitness ( $r=0.41$ ,  $p<0.001$ ), and had a low correlation with their body height ( $r=0.20$ ,  $p<0.05$ ). Participating in some kinds of extracurricular sports training also can prevent being overweighted ( $r=0.22$ ,  $p<0.05$ ).

Many Portuguese school-based children are sedentary in their leisure time; some even are in high risk of CHD. On the contrary, Children who participate on a regular basis at moderate to vigorous physical activity show a significant correlation with physical fit and cardiovascular fitness. Therefore, motivate school-based children to participate on a regular basis at physical activity may establish active lifestyles among young people that would continue into and throughout their future lives as well.

#### O121C-4

### Effects of a health-related tennis program compared to walking/running

**Pfeifer Klaus, Heinz Barb**

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*Keywords: health*

Racket sports are seen as rather inappropriate for health-related sports activities. The goal of the present study was to compare an endurance oriented tennis program for beginners to walking/running.

The participants (46.9  $\pm$  7.7 years (35-63)) were randomly assigned to a 5-week (2x/week) tennis- (TG,  $w=12$ ,  $m=7$ ) or walking-/running program (WG,  $w=12$ ,  $m=2$ ). Main focus of the course units (90') was a self-controlled 30' endurance part (EP) in both groups, flanked with warm-up, a game part and a gymnastics part and ending with a relaxation phase. In the TG EP consisted of tennis specific exercises. Additionally health- and activity-related knowledge was imparted. The aerobic endurance was tested by the 2km-Walking Test before and after the program. The heart rates (HR) of each participant of the whole ES and the rate of perceived exertions (RPE) were sampled to analyse the intensity structure. Additionally, mood (M) and movement concept (MC) were measured.

A two-factor ANOVA (group, time) revealed significant time effects for walking time (16.9  $\pm$  1.2 vs. 17.5  $\pm$  1.3 min,  $p<0.05$ ), estimated VO<sub>2</sub>max (32.2  $\pm$  5.05 vs. 29.2  $\pm$  5.4 ml/min/kg,  $p<0.001$ ), Fitness Index (94.6  $\pm$  12.1 vs. 85.9  $\pm$  13.0,  $p<0.001$ ), MC (24.2  $\pm$  6.2 vs. 26.1  $\pm$  5.2) und M( Aktiviertheit: 7.3  $\pm$  1.7 vs. 6.1  $\pm$  2.3,  $p<0.01$ ). During EP in TG participants showed constant HR (CV: 5.2 - 8.6%) with 6.8  $\pm$  6% deviation from

individually calculated exercise-HR. Accordingly, RPE-values of 11.5  $\pm$  0.3 (7-17) were found.

The choice of specific exercises together with the teaching of knowledge to control training intensity enables an individualized health-related endurance training in tennis, leading to comparable physical and psychological effects like endurance training with walking/running.

#### O121C-5

### Overweight, obesity and gross motor skills of 3 and 4 year old children

**Du Toit Doritha, Pienaar Anitha**

Potchefstroom University for Christian Higher Education, South Africa

*Keywords: preschool children, gross motor skills, obesity*

Childhood obesity has increased over the last two decades, with increasing concern regarding health and other developmental risks. The aim of this study was to examine the prevalence of overweight and obesity and the differences in gross motor skills between overweight and obese 3 and 4 year old children and their nonobese counterparts in Potchefstroom.

Three fundamental motor tasks were qualitatively (the quality of the execution of the skill) and quantitatively (the measurable score given to the performance of the skill, e.g. distance in mm.) assessed in 19 overweight and obese participants and 111 nonobese participants in age-matched groups. The prevalence of obesity (15.83%) found in this sample, corresponds with worldwide and national trends in this age group, but is higher than the prevalence found in South Africa (12%). Differences of statistical significance were established with t-tests as well as non-parametric analysis.

The results showed no differences of statistical significance in the 3 year old group. Differences of statistical significance were found in favour of the nonobese participants in the 4 year old group with regard to quantitative scores for balancing on one leg and quantitative and qualitative scores of catching. Suggesting that overweight and obese children perform poor in comparison with nonobese children in tasks that require good balancing ability and good perceptual and spatial abilities.

The results suggest that the influence of overweight and obesity on gross motor skill development is not significant at 3 years of age, but increases in such measurements that it can impede development at 4 years of age.

#### O121C-6

### Comparison of physical fitness levels of Iranian and American girls and boys aged 9-17 years

**Kashef Majid**

Shahid Rajaei University, Iran

*Keywords: physical fitness, maturation, menstruation*

The aim of this research is to compare physical fitness levels between Iranian and American girls and boys of age 9-17 yrs. Fitness components were compared included: speed, agility, muscular strength, muscular endurance, muscular power and cardiovascular fitness using AAHPERD protocol. 30000 girls and boys students of 9-17 years were tested to make the Iranian national norms and these norms were compared with that of Americans (Mathews 1987) using descriptive analysis methods.

The results showed a higher level of fitness among American girls and boys in all age's studies in compare to Iranian. Nevertheless both norms show fluctuations in different periods 'However Iranian norms remain lower in all stages.

These lower levels of fitness are considered to be due to: lack of enough sports facilities, different social culture, leisure time pattern which lead to inadequate physical activities. Rises and falls pattern in Iranian boys fitness level is similar to American in all ages and all abilities (increases in both groups with growth and puberty). However changes pattern

in the Iranian girls fitness level is quite different from American girls 'which falls down during the maturation period (15-16 yrs. for American and 13-17 for Iranian). Difference in fitness changes pattern of Iranian and American girls is due to: menarche, different in social culture, family culture, leisure time pattern, and their knowledge of physiological changes in menstruation.

*Mathews D, (1987). Measurement in Physical education*

## Symposium

### Physical Activity after Endoprosthetic Surgery

S121D

#### S121D-1

#### Patient activity vs. failure and wear of artificial hip joints - is there a relation?

**Morlock Michael, Honl Matthias**

Technical University Hamburg-Harburg, Germany

*Keywords: rehabilitation, endoprosthesis, activity*

Patients receiving artificial joint implants are getting younger and tend to have higher activity levels. One important question concerns the permissible activity level and sports participation after an artificial joint replacement. The number of scientific studies addressing this issue is small. The guidelines given are quite controversial and range from "lower rate of loosening in patients exercising" to "patients who regularly participate in sporting activity are at twice the long-term risk". From a biomechanical point of view, guidelines should be supported by theoretical considerations based on the failure mechanisms of artificial joints. The dominant mode of failure for artificial joints in general is aseptic loosening due to osteolysis (bone resorption) or stress shielding. Bone resorption around an implant is attributed to macrophage activation caused by wear particles. New bearing materials, coatings, bearing designs, and improved manufacturing techniques have achieved a drastic reduction of wear rates. Stress shielding is caused by unphysiological load transfer of most endoprostheses causing atrophy of formerly loaded (and after joint replacement unloaded) bone. This can be prevented by achieving load transfer as physiological as possible (e.g. "short" neck preserving hip endoprostheses or "hip resurfacing").

The relation between patient activity and the time of hip joint replacements in situ has been established mostly based on data from polyethylen - metal bearings in combination with stemmed femoral components using cemented fixation. The high amount of wear particles created by this bearings together with the limited life duration of bone cement inherently bears the consequence of implant failure. New surgical techniques minimizing soft tissue trauma, improved implant fixation, improved wear performance, and reduced stress shielding together might significantly prolong implant life simultaneously with an increased permissible activity and sport level. The question "what to do after joint replacement" still remains. Individual recommendations regarding post surgical activities as well as the choice of prosthesis and bearing type should be based on the patients activity history prior surgery. It is unwise after a joint replacement to start new technically and physically demanding activities and it is unwise to perform sports with a high injury risk. Activities with a low injury rate bear an acceptable risk and the patients should be encouraged to participate in these activities.

#### S121D-2

#### Activity profile of total knee arthroplasty patients during the day

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*Keywords: physical activity, knee arthroplasty, joint wear*

An aging, yet active population, and the trend to implant prostheses also into the young patient cause increasing numbers of primary knee arthroplasties. Today, patients expect to continue their active life styles after prosthetic surgery. However, wear at the bearing surfaces of the artificial device limits the lifetime of such devices. This study established baseline values of the general, daily activity profile after total knee replacement.

A portable measurement system was used to monitor daily activities. Two absolute inclination sensors attached to the shank and the thigh, and an electro-goniometer, were mounted along the lower extremities of the operated leg. 37 Swiss patients participated in this study after giving informed consent.

It was found that most of the time was spent in sitting (46%), followed by standing (17%) and walking (17%). On average, the patients performed 6600 steps with the operated leg. This number outranged the expected 2700 gait cycles per day (= 1 million gait cycles per year). Since wear is a function of use this needs to be considered for clinical outcome studies.

#### S121D-3

#### Loading of hip implants during jogging, bicycle riding and golfing

**Bergmann Georg, Graichen Friedmar, Rohlmann Antonius**

Benjamin Franklin School of Medicine, Germany

*Keywords: loads, hip joint, endoprosthesis*

People with artificial hip joints are interested whether certain sports activities are permitted. The forces acting at total hip implants are reported here for the fitness activities jogging, golfing and bicycle riding.

Hip endoprostheses with load sensors and telemetry [1, 2, 3, 4] were used to measure the joint contact force in patients (age 58 to 82 years). One of the subjects was investigated during slow jogging. On 3 of them measurements were taken during bicycle riding. From 2 subjects data were obtained during golfing. Both were beginners. The peak values of the hip contact forces are reported here in %BW (percent of body

weight). We compare the loads to those during walking at 4 km/h.

Jogging: During jogging at 8 km/h the peak forces in subject EB were 494%BW (left joint) and 535%BW (right joint), compared to 360%BW (left) and 355%BW (right) during walking at 4km/h.

Bicycle: The peak force increases with power and decrease with speed. At 140 Watt the average peak force from 3 subjects was 132%BW (40rpm) and 97 %BW (60rpm). The absolutely highest value from any trial was 185%BW (40rpm) and 126%BW(60rpm). This must be compared to the 245%BW average of these subjects during walking.

Golfing: The peak force was about 350%BW in the first training lesson of subject HSR and 390%BW in KWR. In HSR it stayed at this level throughout 10 hours of training. The torsional moment was in the range as during fast walking. Average peak forces of 227%BW (HSR) and 228%BW (KWR) were observed during walking at 4 km/h.

High contact forces and torsional moments contribute to implant loosening. For patients with artificial hip joints it is the most widely accepted assumption that excessive force levels in the joint should be avoided. With regard to force magnitudes and torque, jogging is the most detrimental of the three investigated activities. Using a bicycle home trainer causes joint forces which are lower than during slow walking. Playing golf doesn't cause extremely high torque at the endoprosthesis and the peak forces are in the same range as during fast walking at 5 km/h: There are no biomechanical reasons speaking against golfing of patients with stable joint implants or arthrosis.

[1] Bergmann et al. (1988) J. Biomech. 21: 169-176.

[2] Bergmann et al. (1988) J. Biomech. 26: 969-990.

[3] Bergmann et al. (1988) J. Biomech. 34: 859 - 871.

[4] Bergmann (ed) (2001) HIP98, ISBN 3980784800

#### S121D-4

### Physical activity after endoprothetic surgery

Honi Matthias

Agilon Hamburg, Germany

No Abstract

#### S121D-5

### Sports activities after total knee arthroplasty

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University of Innsbruck, Austria

Keywords: knee, arthroplasty

The number of patients undergoing total-knee-arthroplasty is continuously increasing; with populations in industrial nations aging, we increasingly face physically active patients, demanding sports-activity postoperatively.

Sporting-activities of 48 patients were evaluated prospectively. All 48 patients (26 female/22 male) had been active in sports before onset of symptoms. In 24 patients cemented (NexGenR, ZimmerR), in 24 patients cementless arthroplasty was implanted (Natural KneeR, AlloproR). Preoperatively, 29 patients participated in mountain-hiking, 23 in bicycling, 30 in alpine-skiing, 21 in cross-country-skiing and 4 in swimming.

9 patients (28%) continued with all their preferred sports. 16 patients (50%) returned to their preferred sports, but gave up at least one sport they had participated preoperatively. 4 patients (12,5%) gave up at least one previous sporting-

activity, but started with another. 3 patients (9%) never started their preferred sport postoperatively again, but started another sporting-activity. 1 patient continued his preferred sport and even started another (swimming). Postoperatively 29 patients could continue mountain-hiking (minus 25,7%), 15 bicycling (minus 34,8%), 9 alpine skiing (minus 70%), 12 cross-country-skiing (minus 42,9%). 6 patients could participate in swimming (plus 50%), which is the only sports activity with an increasing number postoperatively. 2 patients started with cross-country-skiing postoperatively. All patients were evaluated (Hospital for Special Surgery Score). 18 patients showed excellent results: 94,4% participate in mountain-hiking, 90,9% in bicycling, 37,5% in alpine-skiing, 90% in cross-country-skiing. 14 patients showed good results: they continued mountain-hiking in 68,7%, bicycle-riding in 50%, alpine-skiing in 16%, and cross-country-skiing in 33%. 3 patients started swimming postoperatively, while another 3 stopped. One patient in this group started mountain-hiking postoperatively. 13 patients with fair results participated in mountain-hiking and cycling in 33%, 1 patient returned to alpine-skiing postoperatively. This patient had to undergo revision-surgery for polyethylene-failure. 2 patients stopped cross-country-skiing and 3 patients started to swim. Three patients with bad results completely stopped sports-activities.

Patients should be encouraged to return to their preferred sport after total-knee-arthroplasty, physical inactivity should be avoided. Patients should be informed about risks and how to avoid excessive strains to the implant.

#### S121D-6

### Aims and limits of sports therapy with hip prosthesis patients

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Keywords: strength, eccentric contraction, strength endurance

Deficits remaining after rehabilitation with respect to strength, strength endurance, gait patterns and electrical control in patients with arthritis and prosthesis of the hip are described in detail. In brief, a training program of muscle strength, strength endurance and improvement of aerobic capacity appears meaningful. Training effects can be demonstrated up to 2 years after progressive rehabilitation and thus have long-term effect.

With respect to time, therapy must begin prior to surgery when the diagnosis is first made and should not stop after 6 months after surgery. Starting with static exercises, there should be a rapid transition to concentric forms. Then strength endurance, which still shows great deficits at the end of the rehabilitation period, should be trained. Impairments in coordination should be combated by early gait training, e.g. by progressive weighting in a sling, on the treadmill, or in water. Theoretical considerations appear to justify the use of submaximal eccentric training, especially prior to surgery, since access to the arthritic joint is better due to lower pain inhibition than in concentric forms. Moreover, improvement in coordination can be expected.

Given the continuously increasing costs and reductions in budgets, integration of lower cost sports-therapeutic measures, such as in hip sports groups, is indicated due to the constantly-ageing population with an increasing rate of arthritis. The therapeutic strategy of the damaged arthritic joint must be shifted toward effective alternatives to the existing forms of therapy.

## Oral Session

## Physiology 8: Muscle Physiology

O121E

## O121E-1

**Relation between muscle compound action potential and electrolyte shifts during high-intensity dynamic exercise of different duration****Köhler Silke, Ritzke Holger, Pries Marco, Frankowski Ulf, Shushakov Vladimir, Maassen Norbert**

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*Keywords: fatigue, compound action potential, electrolytes*

In this study the influence of changes of [K<sup>+</sup>] and of pH on the muscular compound action potential and on muscle fatigue was examined during forearm exercise of high intensity and varying duration.

Dynamic hand grip exercise was performed in a horizontal arm position. In a pre-test maximum power of the forearm muscles was determined in an incremental test. The interval test was performed with 60% of the maximum weight reached in the incremental test. The subjects had to squeeze the hand grip with the maximum frequency for 15 seconds. The exercise bout was followed by a 45 seconds rest period. 5 exercise bouts were performed. The fifth bout was varied in duration between 15 and 60 seconds. Blood was taken from a cubital vein. Acid-base-state and plasma electrolytes Na and K (ABL 330, Radiometer), [Lactate] (Biosen 5030, EKF) were determined. Samples were taken at rest after the 1st interval, before, during and after the 5th bout of exercise. An inductive device was used for online registration of the vertical displacement. From this data power and contraction speed were calculated. Skin blood flow was reduced by cooling.

With the beginning of the last exercise bout [K<sup>+</sup>] increased rapidly reaching almost a plateau after 30 s ([K<sup>+</sup>]-increases after 30 s to  $5.9 (\pm 1)$  mmol/l; after 60 s to  $6.3 \pm 0.3$  mmol/l). The time constant of [Na<sup>+</sup>] increase was similar to the one of [K<sup>+</sup>]. [Na<sup>+</sup>]-increase after 60 s of  $1.5 \pm 0.6$  mmol/l was smaller than [K<sup>+</sup>] increase. The change in extracellular [K<sup>+</sup>] correlated with the changes of the m-wave ( $p < 0.001$ ), which in turn correlated with the changes of the contraction velocity ( $y = 3.3x - 274.4$ ). In addition, there was a correlation between the changes of extracellular pH and the propagation velocity of the action potentials ( $y = -79.0x + 99.6$ ). The extracellular [Lac<sup>-</sup>] had no influence on the sarcolemmal electrical events.

The electrolyte shifts during intensive exercise determine the changes of the excitation properties of the sarcolemma. The membrane is depolarised by the elevated [K<sup>+</sup>]. The result is a smaller m-wave. A smaller action potential causes a reduction in muscular force and contraction velocity. Under these circumstances, the increase in extracellular [K<sup>+</sup>] seems to be a cause of muscular fatigue. The changes of pH do not have any direct effects on amplitude and area of the m-wave. However, changes in pH could contribute indirectly by reduction of propagation velocity to muscular fatigue.

## O121E-2

**Simulation of the muscle action potential after handgrip exercise of high intensity****Ritzke Holger, Shushakov Vladimir, Köhler Silke, Frankowski Ulf, Pries Marco, Maassen Norbert**

Medical University Hannover, Germany

*Keywords: potassium, acidosis, muscle compound action potential*

Ionic shifts are often discussed as a possible cause of fatigue during exercise. Potassium accumulation in the interstitium may depolarise the sarcolemma and therefore impair the generation and propagation of the muscle action potential. In our study we examined the recovery of the m-wave after exercise of high intensity in regard to ionic balance. The measured concentrations of Na<sup>+</sup> and K<sup>+</sup> were used for the simulation of the action potential.

The subjects had to squeeze a handgrip with the maximum frequency for 15 seconds. The exercise bout was followed by a 45 seconds rest period. 5 exercise bouts were performed. Blood was taken from a cubital vein. Acid-base-state, plasma electrolytes (Na<sup>+</sup> and K<sup>+</sup>) und [Lactate] were determined. Samples were taken at rest and after the 5th bout of exercise for 15 min. M-wave was recorded from flexor muscles of the forearm just before the blood sampling. The obtained ionic concentrations were used for the simulation of the muscle action potential. The possible effects of the increased activity of the Na<sup>+</sup>-K<sup>+</sup>-pump and the gradient between venous and interstitial potassium concentrations were taken into account. From the initial level of  $4.0 \pm 0.19$  mM/l [K<sup>+</sup>] in plasma reached at the end of the fifth bout  $5.8 \pm 0.65$  mM/l. The average decrease of the m-wave area during exercise was  $33.6 \pm 6.3\%$  ( $p < 0.001$ ). There was a nearly exponential drop of the venous [K<sup>+</sup>] down to  $3.7 \pm 0.21$  mM/l after 1-1.5 minutes of recovery. The m-wave area increased during the recovery period and reached more than 110% of the initial level. During the exercise period and during the recovery a correlation between plasma pH and m-wave was found. The decrease of the pH was accompanied by the broadening of the m-wave. The simulation shows, that the increase of the m-wave during recovery may be mimicked very closely by the curve calculated from the changes of the ion concentrations with regard to a 15% increase of the contribution of the Na<sup>+</sup>-K<sup>+</sup>-pump to the membrane potential.

The results of this study demonstrate that during exercise of high intensity in accordance to increased extracellular potassium the m-wave area became smaller. During recovery m-wave grows in parallel to the potassium decrease. It is possible to simulate the changes of the area of the muscle action potential by using the [K<sup>+</sup>] in plasma. The changes of the pH-level may slow down the propagation of the MAP, but this effect will be distinct only in absence of the other influences.

## O121E-3

**Distribution of Na<sup>+</sup>, K<sup>+</sup>-pumps in skeletal muscle and its significance for maintenance of T-tubular K<sup>+</sup>-homeostasis and fatigue**

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University of Aarhus, Denmark

*Keywords: muscle, potassium, T-tubules*

Active muscle fibres lose K<sup>+</sup>, leading to increased extracellular [K<sup>+</sup>] which may interfere with fibre excitability and cause fatigue. Because of a large ratio between membrane area and the extracellular volume, the build-up of K<sup>+</sup> is exaggerated in the T-tubules. The build-up of extracellular K<sup>+</sup> is counteracted by activation of muscle Na<sup>+</sup>,K<sup>+</sup>-pumps (1). Rat muscle contains both the  $\alpha$ 1 and  $\alpha$ 2 isoform of the Na<sup>+</sup>,K<sup>+</sup>-pump, but  $\alpha$ 2 is the most abundant and the only one present in the T-tubules. To quantify Na<sup>+</sup>,K<sup>+</sup>-pumps in the T-tubules, the content of 3H-ouabain-binding sites was determined in intact muscle fibres and in fibres where the sarcolemma was removed by mechanical skinning.

The  $\alpha$ 2 Na<sup>+</sup>,K<sup>+</sup> pumps were quantified using a 3H-ouabain-binding assay (2). After binding of 3H-ouabain and wash, muscles were transferred to cold paraffin oil (5-8 °C). While under oil, fibres were isolated and mechanically skinned to remove the sarcolemma (3). Fibre volume was calculated from determination of fibre length and diameter. The fibres were cleaned from excessive oil and taken for determination of 3H-ouabain-binding. Also intact fibres and whole muscles were isolated.

In intact fibres the content of 3H-ouabain-binding sites was 421 ± 41 pmol (g muscle)<sup>-1</sup>, which was close to the content found in whole muscle. Importantly, mechanical skinning of fibres only led to a small reduction in 3H-ouabain-binding sites, indicating that 390 pmol Na<sup>+</sup>,K<sup>+</sup>-pumps (g muscle)<sup>-1</sup> or 92 % of the total muscle content of  $\alpha$ 2 Na<sup>+</sup>,K<sup>+</sup>-pumps were located in the T-tubules.

Let alone, the release of K<sup>+</sup> associated with action potentials would in few seconds of muscle activity increase T-tubular [K<sup>+</sup>] to levels that would block further propagation of action potentials (1), thereby making T-tubular excitation a self-limiting process. This study shows that in rat edl, the majority of the Na<sup>+</sup>,K<sup>+</sup>-pumps reside in the T-tubules, providing the T-tubules with a high capacity for counterbalancing the excitation-induced loss of K<sup>+</sup>.

Clausen T (2003). *Physiol rev* (in press)Clausen T, Hansen O (1977). *J Physiol* 270: 415-430Lamb G, Stephenson G (1990). *J Physiol* 423: 495-517

## O121E-4

**The effect of long term exercise on the expression and localisation of insulin-like growth factor I receptor in rat skeletal muscle: an immunohistochemical study**

Zander Maren, Matsakas Antonios, Schulz Thorsten, Diel Patrick

German Sport University Cologne, Germany

*Keywords: wheel running, insulin-like growth factor I, immunohistochemistry*

A lot of attention has been drawn to the insulin-like growth factor system (IGFsystem) over the past few years because it influences cell proliferation and differentiation in various tissues. The critical elements that regulate insulin-like growth factor (IGF) function include ligands, receptors and IGF-binding proteins (IGFBPs). The purpose of the present study

was to establish a method to analyse the expression and localisation of the IGF-I receptor (IGF-IR) in skeletal muscle in response to exercise.

Eight female Sprague Dawley rats were divided into a study group (n=4) and a control group (n=4). The study group was undertaken a voluntary endurance exercise program in running wheels for twelve weeks, while the control group remained sedentary. IGF-IR immunohistochemical staining method (PAP) was established for rat paraffin embedded tissue derived from the gastrocnemius muscle. The method was optimised using rat liver and uterus tissue.

Specific IGF-IR staining resulted in immunoreactivity patterns in distinct, moderate to strong, immunostained stripes of muscle fibres. Analysis of the effect of physical activity on the expression and localisation of IGF-IR in the gastrocnemius muscle reveal no obvious differences between trained and untrained animals. In this study we demonstrated the development of a functional detection system for IGF-IR expression in the rat skeletal muscle. So far no immunohistochemical data is available regarding the regulation and localisation of IGF-IR in the skeletal muscle under exercise conditions. This data provides new evidence that the IGF-IR expression is not modulated by exercise in the gastrocnemius muscle, at least under the training conditions chosen.

Whether IGF-IR staining is muscle fiber type specific remains unclear and has yet to be studied in detail. In any case, further investigations considering the whole IGF system in muscle and serum are required in order to elucidate the role of the IGF system and primarily the IGF-I receptor in tissue growth and development in response to exercise.

## O121E-5

**Skeletal muscle oxygen uptake and blood flow at different contraction frequencies**

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Norwegian University of Physical Education and Sport, Norway

*Keywords: oxygen uptake, blood flow, contraction frequencies*

A considerable effort has been put into studying muscle efficiency in humans during exercise at different speeds of shortening. Traditionally, whole body exercise such as cycling at a constant workload has been used in which pulmonary oxygen uptake has been shown to increase as contraction frequency (cadence) increases. However, it is not clear whether the differences in pulmonary oxygen uptake reflect a difference in the oxygen uptake of the contracting muscle. The aim of the present study was to test the hypothesis that human skeletal muscle oxygen uptake are elevated at high (100 rpm) compared to moderate (80 rpm) contraction frequencies.

Six subjects of both sexes participated. Their age was 23 (20-25) years, weight 66 (59-75) kg and maximal oxygen uptake 59 (50-72) ml/kg·min. Both legs of each subject were separately tested at both 80 and 100 rpm (randomised order) on an electromagnetically braked cycle ergometer (Lode Excalibur Sport) and pooled together in a subsequent analysis. External power was 60 Watt for females and 75 Watt for males at both cadences. Each workload lasted 8 min and was separated with 5 min rest in between. Blood samples were taken after 3 and 6 min at each workload from one artery (brachialis) and both vena femoralis. Blood flow was determined by the thermodilution technique (Andersen & Saltin 1985) in vena femoralis immediately after blood

samples were taken. Leg muscle oxygen uptake and lactate release were calculated from arterial venous differences and leg blood flow.

Leg oxygen uptake was 12.6% higher at 100 compared to 80 rpm ( $p < 0.05$ ). This was mainly caused by a 9.6% higher blood flow at 100 compared to 80 rpm. The remaining difference was explained by a higher a-v O<sub>2</sub> diff at 100 rpm partially due to a higher arterial [Hb] compared to 80 rpm (13.5 vs. 13.3 g/dl,  $p < 0.05$ ). Also leg lactate release was higher at 100 compared to 80 rpm ( $p < 0.05$ ).

This study supports the hypothesis that skeletal muscle oxygen uptake is greater at high (100 rpm) compared to moderate (80 rpm) contraction frequencies (cadences). This difference was explained mainly by a larger leg blood flow. Also leg lactate release was considerably higher at 100 compared to 80 rpm. Together, these data reveal that the energy requirement of the exercising muscles is higher at a high compared to a moderate contraction frequency.

Andersen P, Saltin B (1985). *J. Physiol* 366: 233-249

## O121E-6

### Clinical trial to obtain the twin effect of a diet, accompanied with a specific aerobic exercise program to decline weight, triglycerid and total cholestrol in the shortest period without drug usage

**Dineli Artadad**

Sports Medicine Federation of Iran, Iran

**Keywords:** hypercholesterolemia, hypertriglyceridemia, overweight

Over weight, hypercholesterolemia & hyper-triglyceridemia are crucial risk factors of cardiopulmonary diseases & drugs. Hard diets & long heavy sports are not useful sufficiently. Therefore I decided to conduct the present study.

Among my patients, those who had these 3 risk factors all together were studied. Special diet (800-1200 Kcal/Day) with an aerobic exercise program (12 Min. treadmill+rowing+fixed bicycle with 60-65% max. power) were applied for 2 months. The mean of all 3 risk factors have had remarkable difference before & after method for all cases (14m, 18f) & P.value=0.000. Weight: (mean before method=81.6) (mean after method=65.4) (95% CI=17.9-14.4) T.Ch: (mean before method=438.0) (mean after method= 163.5) (95% CI=335.9-212.9) T.G: (mean before method=368.6) (mean after method=120.1) (95% CI=317.5-179.5)

To compare with usual diets, this diet is more comfortable. The aerobic exercise program takes shorter period & is easier. This method gives highest efficacy in 2 months with no drug usage.

## Symposium

### High Performance Cycling

**S121F**

#### S121F-1

### Physiological demands of professional cycling

**Jeukendrup Asker**

University of Birmingham, United Kingdom

**Keywords:** cycling, power output, elite sport

Road cycling consists of events lasting only a few minutes (time trials) to events lasting up to 3 weeks (major stage races). The energy expenditures during races like the Tour de France are among the highest ever reported for endurance athletes: during long or mountain stages 36 MJ/day may be expended. In order to maintain energy balance such expenditure has to be compensated by an equal energy intake. Racing at this level requires a high level of aerobic endurance, coupled with an enhanced muscular-enzymatic system, but it also places considerable demands on the gastro-intestinal tract.

The high physiological demands are mirrored in the high aerobic capacity and other physiological characteristics of elite cyclists. Studies in literature report VO<sub>2</sub>max values between 70 and 83 ml/kg.min while lactate thresholds are typically at very high percentages of the maximal oxygen uptake (80-85%VO<sub>2</sub>max). It has also been shown that elite cyclists have high percentage of type I muscle fibers which have been linked to their suggested superior efficiency. However, we recently demonstrated that professional cyclists were no more efficient than recreational cyclists, despite

obvious differences in training background, cycling experience and aerobic capacity.

During one-day races and stage races like the Tour de France very high power outputs have been observed for prolonged periods of time. With the sustained high power outputs and efficiencies of 20-22%, considerable amounts of heat are produced and this heat has to be dissipated. A rise in core temperature cannot be prevented but it has been suggested that core temperature is an important determinant of performance. In uphill cycling, two factors change dramatically. The rate of heat production is greatly increased and the reduced speed means that the potential for heat loss by convection is greatly decreased. Metabolic heat production for top riders during a sustained climb may exceed 2,000 W. If heat is not lost from the body, this would be sufficient to cause body temperature to rise rapidly, and intolerable levels would be reached within a few minutes if an effective heat loss mechanism is not in operation. This raises questions about the effects of warm-up and the potential benefits of pre-cooling.

This presentation will give an overview of the current literature on road cycling and will use practical examples and will set the scene for the presentations that will follow in this symposium.

## S121F-2

**Evaluation and training of power production in elite cyclists****Van Leemputte Marc, Hespel Peter**

Catholic University Leuven, Belgium

*Keywords: cycling, isokinetics, time trial*

Success in a cycling race depends on many components, however in the time trial (TT) it is most dependent on the athletes' physical ability to generate power to the pedals. A first aim of the presented studies is to specify determinant factors of isokinetic power measurements, as measured in a lab environment, for predicting time trial performance of elite cyclists. Secondary the aim is to search for specific training methods that effect these determinant factors and to evaluate the impact on performance.

Since muscle power is the product of muscle force and contraction speed, isokinetic maximal torque production of the lower limb at different velocities (40, 80, 90, 100, 110, 120 rev/min) were measured using the riders bike to eliminate the effect of riding position. In addition, isokinetic 30 s Wingate tests were performed at different velocities. 15 high level cyclists were tested before and after a training period of 6 weeks. The training consisted of short maximal isokinetic cycling at 80-100 rev/min. Five elite cyclists were tested before and after a period of training advice.

TT performance was predicted with a coefficient of non-determination of 12 %, based on 1) maximal power during isokinetic cycling at 40 rev/min and 2) the fatigue index as derived from the Wingate test. The velocity at which the test was performed had no significant effect on the predictive value of the fatigue index. After training TT significantly increased (7%) but only the second factor was affected. However, after training the same prediction accuracy was found. The elite cyclists were predicted as better riders, although specific shortcomings were detected. After a period with training following specific recommendations, the TT performance of these cyclists significantly improved.

Mechanical power output measurements during maximal isokinetic cycling give valuable information to estimate TT performance. The preliminary results of training suggest that from these measurements valid training recommendations can be derived.

## S121F-3

**Power profiles during competitive road cycling: what are faster riders doing?****Martin DT, McLean BD, Ebert TR, Gardner AS, Lee H, Lawton E, Ricketson JW, Edwards ML**

Australian Institute of Sport, Australia

*Keywords: cycling, performance, power analysis*

What does it take for a competitive road cyclist to ride in the front bunch? The primary aim of this study was to compare power profiles associated with "Fast" and "Slower" race performances produced Australian male road cyclists competing in an international stage race.

From 1999-2003 Australian Institute of Sport male road cycling scholarship (n=22) holders agreed to compete in the "Tour Down Under" stage race with SRM power meters (professional version, Julich, Germany) attached to their bicycles. Stage 2 was always between 130-145 km and race time ranged from 3.5-4.1 hours. A total of 27 race profiles were divided into two groups – "Fast" races (>38 kph) and "Slower" races (<38 kph).

As expected, cyclists who maintained higher average race speed produced a higher average power output and spent less time (~15min less) at zero power output. Despite the duration of the race (~3.7 hrs) faster cyclists also spent more time at extremely high power outputs (>12 W.kg<sup>-1</sup>) and tended to produce a higher maximum mean power over durations ranging from 5sec to 4min. Faster cyclists tended to be lighter (68 vs 71 kg) and possess a higher VO<sub>2</sub>max (77 vs 73 ml.kg.min<sup>-1</sup>). Of particular interest was the amount of time (~1min) faster cyclists spent at very high power outputs (>12 W.kg<sup>-1</sup>). On average, faster cyclists also produced ~1.5 W.kg<sup>-1</sup> more power for the most intense 5sec sprint in the race. When racing over rolling terrain, faster cyclists produce multiple high intensity surges >12 W.kg<sup>-1</sup>.

Further research is required to determine whether exceptional aerobic fitness enables cyclists to repeatedly display their maximal sprint capabilities or whether exceptional sprint power is required to repeatedly produce short, high power sprints.

**Symposium****Elite Soccer****S121G**

## S121G-1

**Training in the context of the physiological demands of soccer****Reilly Thomas**

Liverpool John Moores University, England

*Keywords: intensity, soccer, physiological response*

The exercise intensity associated with competitive soccer engages all of the metabolic energy systems. Whilst the aerobic system is implicated in a major way throughout match-play, crucial aspects of play are dependent on anaerobic performance. Speed over short distances is a characteristic of top performers. There are also requirements for muscle strength and agility. Serial studies of motion analysis during games indicate that the exercise intensity has increased over recent years. Nevertheless there are unique

stresses associated with positional roles that must be taken into account in planning personalised training programmes.

A further complication is the schedule of competitive engagements of professional teams. The weekly programme is variable according to the day of competition which is no longer consistent from week to week. Furthermore, knock-out and complementary matches can add to the physiological load on players and contribute more irregularity in their calendar. In the face of the competitive schedule, the training must constitute a balance between maintenance of fitness on one hand and avoiding over-reaching on the other. There are as yet no definitive markers that identify vulnerable individuals in advance.

Seasonal influences vary in complexity once professionals return to training. The period between matches is a cycle of recovery-training- taper. Nutritional strategies to prepare for the next engagement have been adopted for some years. Contemporary approaches incorporate intervention strategies as well as diet in accelerating the recovery from the demands

of match-play. Such methods must still be integrated within the overall training plan.

In view of the need for highly efficient training programmes, practising with the ball can be exploited for purposes of recovery, fitness maintenance and strenuous training. These drills may employ small-group games, conditioned games and position-specific rules. In such cases practices provide motivational stimuli to secure a more relevant physiological response.

### S121G-2

#### Monitoring training load in football

**Impellizzeri Franco M**

Sport Service MAPEI srl, Italy

*Keywords: soccer, heart rate, rate of perceived exertion*

An important step in the training process is the control and monitoring of the training load in order to verify that the planned programme has been imposed an effective training stimulus on the athletes. There have been several attempts to quantify training in a single term (Foster, 1998; 2001; Banister, 1991) especially for endurance athletes. One of the most interesting strategies to quantify training load is the one recently suggested by Foster (1998). This method quantifies the TL as the product of the whole training session RPE by its duration (RPE-TRIMP) and it seems to be also useful in game sports like basketball, which training is characterized by both aerobic and anaerobic exercises. The aim of our investigation was to verify the validity of this training load quantification in soccer, using various HR based methods as reference.

Nineteen young soccer players were involved in the study. During 7 weeks their training sessions HR were recorded using HR telemetric system. The RPE-TRIMP were determined multiply session RPE by the min of training. Several HR based TL were determined: Banister's TRIMP, Edwards' TRIMP, training duration multiply by mean training session HR expressed in % of HRmax, of lactate thresholds' HR and HR reserve. Pearson's product moment correlation was determined to verify the individual relationship between RPE-TRIMP and various HR based methods.

Training loads of 479 training sessions were collected. The mean individual correlations between various methods of TL quantifications and RPE-TRIMP range from 0.60 to 0.70 ( $p < 0.05$ ).

The results of this study extend the validity of Foster's RPE-TRIMP in quantify training load in soccer training. The validity was verified assuming HR as the best way to describe TL. However, HR could not reflect as well as RPE the contribution of anaerobic exercises to the overall TL. In fact, Drust et al. (2000) found a similar VO<sub>2</sub> and HR during intermittent exercise on a treadmill simulating soccer activities compared to continuous exercise at the same mean velocity, while ventilation and RPE were significantly higher during the intermittent trial. In conclusion, we suggest this simple quantification method to monitor and to control soccer training load.

*Banister EW (1991). In: Physiological testing of elite athletes; Drust B, et al (2000). J Sports Sci. 18 :885-892 ; Foster C (1998). Med Sci Sports Exerc. 30(7):1164-1168; Foster C, et al (2001). J Strength Cond Res. 15(1):109-115*

### S121G-3

#### Psychological support in a soccer setting

**Gilbourne David**

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*Keywords: soccer, psychology, coach*

The applied literature outlines many examples of different consultation approaches or philosophies. These frameworks for consultancy may also suggest that certain practitioner skills. This important applied debate is rather inwardly focused in the sense that sport psychologists often communicate consultancy ideas to inform and (maybe) influence their peers. The presentation overviews this material and considers how different approaches to consultancy might function within a soccer setting. This exercise draws from applied experiences gained the soccer-based consultations and from longitudinal supervisory activity undertaken in conjunction with UK Premiership teams. More specifically, themes and processes associated with the coach/psychologist axis, therapeutic role boundaries and psychologist training are addressed.

### S121G-4

#### Soccer specific conditioning

**Hoff Jan**

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*Keywords: soccer, training, specificity*

Stop soccer players do not have an extraordinary capacity in any of the areas of physical performance. Soccer training is largely based on the game itself, and a common recruitment pattern from player to coach and manager reinforces this tradition. Understanding adaptive processes to circulation and endurance performance as well as nerve and muscle adaptations to training and performance have given rise to more effective training interventions. New developments in physiological research have shown that training for VO<sub>2</sub>max is the most important feature for endurance in soccer play, and that 3 to 8 minute intervals at 90 to 95% of maximal heart frequency with intervening lactate elimination periods enhance both aerobic endurance capacity and soccer performance. This type of training is normally conducted during uphill running. New research shows that small group play might be used giving similar training responses with a possible ceiling effect around 65 mL per kilo and minute.

Ball dribbling paths may however be constructed to obtain similar physiological loads and training responses as uphill running. New developments in strength training research show that maximal strength training using high loads (85%+ of 1RM), few repetitions and maximal intended velocity in the concentric action gives high responses on sprints and jumps for soccer players. The fact that the same training also enhances aerobic performance through improved work economy is another important reason for introducing this type of training. Soccer specificity in strength training is only possible in terms of strengthening the specific muscle groups used during matches. A weight room and heavy loads are necessary to gain the optimal accelerative force. The new developments in physical training have important implications for the success of soccer players. The challenge now is to act upon the new developments and change existing training practice both for coaches and players.



## Symposium

### Exercise and Cancer

S121H

#### S121H-1

##### Exercise and breast cancer

**Thune Inger**

The Norwegian Cancer Society, Norway

No Abstract

#### S121H-2

##### Protective effect of exercise on cancer - which mechanisms?

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*Keywords: epidemiology, cancer, mechanisms*

Cancer is a multifactorial disease with complex interactions between genetic and environmental factors. In human epidemiologic studies, regular physical activity (measured as recreational or occupational activity) is associated with significant colon cancer risk reduction. In animal experimental studies, exercise training is associated with reduced incidence or longer latency of chemically-induced tumours in the colon. Various mechanisms for the physical activity/exercise-colon cancer association have been hypothesized in the medical literature, although few mechanisms have been empirically tested. The purpose of this presentation is to review the scientific evidence on physical activity and colon cancer in relation to the hypothesized biological mechanisms.

A multistage systematic review of the literature was conducted using a variety of medical databases from 1970-2002, using the terms "colorectal cancer, colon cancer, neoplasm, carcinoma, exercise, fitness, and physical activity."

The result of the searches yielded 330 articles of which 23 review articles were identified which included reference or discussion of proposed biological mechanisms for the association. Following identification of possible mechanisms, additional searches were conducted to identify empirical studies in the exercise literature supporting these mechanisms. The mechanisms considered included changes in gastrointestinal transit time, immune function, prostaglandin levels, insulin-like growth factors, bile acid secretion, serum cholesterol and gastrointestinal and pancreatic hormone profile.

The published evidence for these hypothesized mechanisms of colon cancer risk reduction, as well as recent findings from my laboratory on intestinal and colonic gamma delta CD8 T lymphocytes in response to exercise, will be considered in this presentation. It is likely that no one mechanism is responsible for the cancer risk reduction observed in epidemiological and animal studies and, therefore, the observed benefits of physical activity for colon cancer risk may be a combination of factors.

Research supported by a grant from NSERC of Canada

#### S121H-3

##### Exercise training and macrophage function in aged subjects

**Woods J A, Lu Q, Ceddia M A, Yoon P, Hartman M, Freund G G**

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*Keywords: immune function, aging, macrophage*

In these experiments, we determined the effects of age and exercise training on resident peritoneal macrophage (Mo) responsiveness to IFN-gamma (IFN-g) and lipopolysaccharide (LPS) in young (6 month) and aged (22 month) male Balb/c mice by measuring cytolytic ability and production of reactive nitrogen products.

Mo's were incubated with various concentrations of IFN-g and LPS for 24 hrs. After washing, P815 tumor cells were utilized as targets in a 16 hr 51Cr release assay.

We found that aging resulted in a significant reduction in the ability of Mo's to respond to the highest doses of IFN-g and LPS and kill P815 cells (young 46 + 4% vs. old 34 + 2% killing). Exercise training significantly increased Mo cytotoxicity in both age groups (66 + 7% vs. 44 + 2%, in young and old mice respectively), this effect was larger in the young mice. Mo's from young exercised mice also produced significantly (~50-60%) more NO<sub>2</sub><sup>-</sup>, there was a tendency for higher NO<sub>2</sub><sup>-</sup> in old exercisers. The inducible nitric oxide synthase (iNOS) inhibitor NNMA significantly reduced Mo cytotoxicity and NO<sub>2</sub><sup>-</sup> production and completely abrogated exercise-induced increases in these measures. RT-PCR analysis revealed significantly higher iNOS mRNA levels in Mo's obtained from the exercise trained mice and significantly lower iNOS mRNA in old when compared to young mice.

We concluded that aging reduces, and exercise training increases, the capacity of resident peritoneal Mo's to respond to IFN-g and LPS with increased tumor cytotoxicity. Enhanced iNOS gene expression and NO<sub>2</sub><sup>-</sup> production are likely the contributing mechanisms of the exercise-induced enhancement of cytotoxicity in young mice. While NNMA did block the exercise-induced increase in cytotoxicity, exercise did not increase NO<sub>2</sub><sup>-</sup> or iNOS gene expression in the old mice, indicating perhaps the contribution of other cytolytic mechanisms in old mice. To further identify age-related defects in Mo signaling, we examined early signaling events in Mo's after stimulation with INF-g. Western blot analysis revealed a reduction in tyrosine phosphorylated Stat-1 in protein obtained from the old when compared to young mice. In conclusion, impaired IFN-g signaling may be responsible for the reduced in vitro Mo function seen in aged mice. Future experiments will determine the role of exercise training as a means of improving age-related signaling defects in the IFN-g pathway will be explored.

## Oral Session

## Biomechanics 10

O121I

O121I-1

**Characteristics of the early flight phase in the Olympic ski jumping competition**

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*Keywords:* ski-jumping, Olympics

Early flight is considered as crucial phase for the length of the jump in ski jumping. An earlier study in the Olympic K-90 m hill competition (Arndt et al 1995) showed that ballistic parameters of center of mass (CM) during early flight did not provide any major contributions to the total distance of the best jumps. However, a combination of five defined flight angles at 17 m with distance as the depended variable, gave an R<sup>2</sup> value of .84. It is known that the flight phase in small 90 m hill does not play a role as important as in larger K-120 m hill and therefore the purpose of the present study was to identify flight characteristics during the early flight phase of the Winter Olympic large hill competition.

All jumps of the individual competition of the K-120 m hill were filmed using two high-speed video cameras (HSC-200) with Pan & Tilt heads (Peak Performance Technologies, Inc.) operating at 200 fps. Two cameras followed the jumpers through the early flight phase covering approximately one third of the longest jumps. Selected jumps from the final (2nd) round were chosen for further analysis. Various CM and angular parameters were analyzed to identify important factors during this phase. Correlations between all analyzed variables were calculated and the jumpers with different levels of performance were divided into subgroups and compared.

Differences in performance levels of jumpers participating in the final round were remarkable ranging from 105 m to 133 m in jumping distance. The angle between body (line connecting ankle and shoulder joints) and skis defines the forward leaning obtained by the jumpers well. Body/ski angle correlated significantly to the length of the jump both at the first phase of the flight (0 - 0.1 s,  $r = -.549$ ,  $p < .01$ ) and during the entire latter part of the early flight. The highest correlation reached a value  $r = -.714$  ( $p < .001$ ) 1 - 1.1 s after the release instant. Ski angle of attack was also related to the jumping distance in the same phases ( $r = .509$ ,  $p < .05$  and  $r = .585$ ,  $p < .01$ , respectively). Thus the skis should be lifted immediately after the release. Instant and careful control is needed for not leaning too much forward at the phase around 1 s after the release. A too strong forward leaning was emphasized probably because of the low air density caused by high altitude of the ski jumping stadium in this competition.

Arndt, A. et al (1995). J Appl Biomech 11, 224 - 237.

O121I-2

**Poling 3-D kinematics of elite skiers in classical and free technique of cross-country skiing engaged in World Cup and Championships races (1995-2003)**

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Italian Federation for Winter Sports, Italy

*Keywords:* 3D analysis, cross-country skiing

In the last 30 years the progressive improvement of the skating technique, the equipment and the track, determined great changes in (CCS) also in the classical technique. For example the skiers use the Double Poling (DP) or V2 skating also in moderate uphill, in spite of the Diagonal Stride (DS) or V1 skating. The aim of this study was to investigate the positioning of the upper-body limbs at the beginning of the poling in different techniques and ski track conditions.

The data collection was performed since 1995 during various men's WC CCS races. A couple of digital camcorders were located in each race, on flat section and on an uphill section (6°-9°). Due to the technical requirement of a wide working volume, dedicated software for video analysis, with free panning, tilting and zooming TV cameras were used. Calibration was performed by means of DLT method. A minimum of ten skiers, were considered in this work. The parameters considered were: CL (m), CT (s), Vave (m/s), % Time-Poling/CT, CG Vertical Displacement (m), Elbow Angle (°) at Pole Plant (PP), Elbow Angle (°) min, Shoulder Angle (°) at PP, Poles Angle (°) at PP.

The values for each technique considered were respectively: Classic DS-Uphill (9°):  $3.2 \pm 0.2$ ,  $0.96 \pm 0.07$ ,  $3.23 \pm 0.18$ ,  $51\% \pm 1\%$ ,  $0.08 \pm 0.02$ ,  $88 \pm 13$ ,  $83 \pm 10$ ,  $86 \pm 24$ ,  $37 \pm 3$ .

Classic DP - Flat:  $7.9 \pm 1.1$ ,  $1.30 \pm 0.14$ ,  $5.7 \pm 2.5$ ,  $23\% \pm 1\%$ ,  $0.19 \pm 0.04$ ,  $111 \pm 10$ ,  $91 \pm 13$ ,  $94 \pm 11$ ,  $17.5 \pm 6.4$ .

Free V2 - Uphill (6°):  $3.88 \pm 0.19$ ,  $0.98 \pm 0.02$ ,  $3.96 \pm 0.14$ ,  $34.5\% \pm 0.3\%$ ,  $0.23 \pm 0.03$ ,  $99 \pm 9$ ,  $92 \pm 8$ ,  $93 \pm 15$ ,  $24 \pm 7$ .

Free V2 - Flat:  $5.88 \pm 0.35$ ,  $0.91 \pm 0.06$ ,  $6.48 \pm 0.27$ ,  $24.0\% \pm 0.3\%$ ,  $0.19 \pm 0.02$ ,  $93 \pm 4$ ,  $89 \pm 4$ ,  $85 \pm 20$ ,  $35 \pm 10$ .

According to previous studies, we found that the faster skiers had longer cycle lengths than the slower ones. The kinematic patterns of shoulder, elbows and poles angles were found to be quite similar to literature data. It seems that the key point of the poling for every technique is the pole plant (PP) and the positioning of the upper-body limbs. For example an elbow angle at the PP is quite 90° in all case and does not change in the first part of the poling. However the skiers adopted different strategies to perform the poling with respect to the trunk, shoulder and elbow rotations. The individual patterns of this and additional biomechanic parameters are also discussed with reference to the potential significance for the optimisation of the overall movement performance.

O121I-3

### Dynamic behavior of alpine ski bindings: Investigations to solve existing problems

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*Keywords: alpine skiing, safety, sport equipment*

Whereas a standard (ISO/DIN 9465) exists for the front part of alpine ski bindings describing requirements regarding dynamic behavior, no standard exists for the rear part. Technical deficiencies here may be the cause for inadvertent releases. To avoid those and falls resulting hereof many expert skiers tend to increase their setting values, sometimes by even more than two indicator steps. This modification however may dramatically increase their injury risk in a regular fall situation. This dilemma can only be solved by optimizing the dynamic behavior of the binding's heel part.

7 different commercially available bindings each mounted on a ski were supplied by 4 manufacturers. All bindings were set to an equal release level of 1 kN and adjusted to a standard test sole. Quasi-static and dynamic release tests under different loading conditions were then carried out. In the quasi-static test the skis were either mounted to a plane surface or fixed in a bended position. Increasing vertical force was applied to the heel of the test sole and its displacement at release sqstatic was measured. In the dynamic tests impacts from above and from below were carried out on the ski's tail and the ski's tip respectively. By varying the fall height of the impact mass the maximum tolerable impact energy (TIE) each binding is able to absorb was determined. Using high speed video the heel displacement sdyn at TIE level was then recorded.

Unexpectedly the ski deformation had almost no influence on sqstatic. No relationship between sqstatic and the tolerable impact energy could be found ( $r^2=0.20$ ), however a strong relationship exists between sdyn and TIE ( $r^2=0.87$ ). Looking at the absolute values of sqstatic the 7 bindings were not much different, but the tolerable impact energy showed significant variation. Their values (related to the mean of all bindings tested) range from 46% to 201%. (In contrast the measured values for sqstatic lie between 93% and 124%). This means that binding models exist, which have a more than four times higher dynamic capacity than others.

The experiments clearly confirm the observation that regarding dynamic behavior severe differences exist between today's alpine ski bindings. The current binding tests according to the existing ISO standard can not sufficiently predict the bindings safety performance especially regarding the problem of inadvertent release.

O121I-4

### The influence of the angle of inclination upon the low back of professional cyclists

**Verlinden Marc, Goris Walter, Den Ouden Natascha, Walvoort Marc, Van Roy Peter, Clarijs Jan-Pieter**

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*Keywords: cycling, low back pain, spine*

The study tries to find out why professional cyclists show low back pain problems after being subjected to a long drive during inclination. Epidemiological research shows low back pain during cyclic activity. A complex system of ligaments suffers from visco-elastic forces and fatigue. Muscular force of low back region is the most important active stabiliser of the low back (Solomonow et al, 1998, Stubbs et al 1998). Sport specific and functional multidisciplinary research

towards body attitudes and muscular activity of the low back region may shed some light upon the aetiology of musculo-skeletal low back disorders on cyclists.

14 professional Belgian cyclists have been subjected to a set of anthropological measurements and flexibility-tests to catalogue body properties and a questionnaire - to determine the type of athlete and weather the cyclists will be classified in the control group (CG) or the low-back-pain-group (LBPG). During a simulated hill-drive (sub maximal efforts) upon own bikes - with hands on the brakes, cycle frequency of 80 rpm - using an inclinable platform and an ergo meter (Tackx system), EMG patterns, back dynamics, perceived exertion and heart frequency were registered. 1. Anthropometrical data showed that both groups had exactly the same mean body height, but all other measurements were larger/greater for the LBPG. These results are checked with bike-dimensions. 2. There was a reverse proportionality on perceived exertion (Borg) and pain experience (VAS). 3. Explicit asymmetric positioning during drive: left rotation of trunk and left lateroflexion of the body with all cyclists. 4. The greater the effort and inclination, the lower the muscular activity of Para vertebral muscles. Independent of the inclination, the greater the effort the more a shift from left side of the body towards the right side, of muscular activity is observed. Probably for consolidation of the pelvis.

Other studies (Solomonow 1999) find similar results. Possible visco elastic changes of the lumbar spine can catalyse a lesser degree of sensitivity of the mechanoreceptors, with the consequence of a lesser reflexive muscular activity (EMG). Accumulated with the adaptation of the trunk position in function of the angle of inclination, lower activity of the Para vertebral muscular force means less active stabilising of the spine, resulting in higher range of motion values of the LBPG. Rest periods and full consuming of recuperation time is a possible solution of the problem.

O121I-5

### 3D arthrokinematics of the humeroulnar joint

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*Keywords: arthrokinematics, elbow, manual therapy*

The aim of this study was to collect quantitative differentiation in kinematic behaviour during flexion-extension of the humeroulnar joint.

Seven upper extremities were taken from fresh human cadavers at the level of the humeral head. Each specimen was clamped on a rigid stand to hold the humerus in such a way that the elbow was fully free to move. 3D electromagnetic tracking sensors were fixed on the humerus and ulna. Subsequently, each elbow was moved in flexion/extension with the forearm supinated, with the forearm pronated and with the forearm in the anatomical position, and in valgus/varus in 10° flexion. The positions and rotations of each sensor were collected. The individual sensor data were used to determine the data of a Cardan approach and the parameters of the finite helical axes for discrete sampling ranges of flexion/extension between the different bones: i.e. orientation, position, shift along and rotation about the estimated helical axis. At a later stage, the positions of local anatomical landmarks and joint surface configurations were digitized with a 3D drawing stylus. These anatomical data were used for the definition of local bone embedded or articular surface embedded co-ordinate axes to refer to. To analyze the 3D intra articular flexion/extension kinematics of the humero-ulnar joint, the finite helical axes were related to a

co-ordinate system based on the center line through the trochlea and the longitudinal axis of the humerus.

With extension the combination of extension/valgus/external rotation Cardan angles was demonstrated. The translation of the center of the ulnar embedded co-ordinate system demonstrated a lateral component. With elbow extension, an extension helical angle is continuously coupled to varus and external rotation helical angles. As a result, the combination of extension/exorotation/varus helical angles will project the longitudinal axis of the ulna in the frontal plane of the humeral embedded coordinate system with a floating valgus angle, and in the transversal plane with a floating external rotation angle. For all specimens, the patterns of change for varus and external rotation helical angles related to the extension helical angle were independent of forearm position (neutral, supination or pronation). The clinical impact of the obtained results will be discussed in context of mobilizing and manipulating techniques as used in manual therapy.

O121I-6

### Fatigue induced changes on the three dimensional kinematics of 400 meters hurdle clearance

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*Keywords: fatigue, 3D kinematics, 400m hurdles*

The 400 meters hurdle running is very demanding in physical terms, involving a velocity effort at maximum intensity, which requires an excellent level of anaerobic capacity. During this running event ten hurdles have to be cleared. After the early beginning, the individual technique may be affected by fatigue. To maintain the best performance during the last phase of the run, the athlete should try to stabilize his individual clearance technique. The purpose of this study

was to investigate kinematic changes on the hurdle clearances induced by a specially designed fatigue protocol intended to simulate the 400 meters hurdles.

Nine national elite male athletes (body mass  $73.17 \pm 5.78$  Kg; height  $1.83 \pm 0.06$  m; age  $24.89 \pm 5.49$  years old; 400 mH best  $51.28 \pm 1.76$  s) participated in this study. The performance of the clearance action was video recorded at 100 Hz, using four video cameras. Three-dimensional coordinates of the athlete body joints were calculated. Linear and angular displacement and velocity parameters and total body centre of mass (BCM) were calculated. These procedures were repeated before and after a fatigue protocol. The validity of the fatigue protocol (FP) was verified comparing the blood lactate concentration (BLC) obtained at the end of that protocol with the blood lactate concentration obtained at the National Championships (NC) held two days before. Four of the tested athletes were compared (BLC: NC  $17.83 \pm 3.12$ ; FP:  $17.25 \pm 3.17$ , p-value 0.15).

In fatigue conditions there was a decrease of the horizontal velocity of the centre of gravity (CG) ( $p < 0.001$ ), which was accompanied by a significant reduction of the clearance amplitude, take-off distance and landing distance. Fatigue induced an increase on the take-off and landing time ( $p < 0.01$ ). Our main results showed that fatigue caused a significant reduction in both the horizontal velocity of the BCM and horizontal clearance distance. The latter was mainly due to a smaller horizontal take-off distance.

These data associated with the increase of the vertical clearance displacement of the CG and the smaller take off angle allowed us to conclude that the athlete's clearance technique was affected. The anaerobic fatigue should have caused a loss of muscle power and stiffness that could explain the increase of the contact time for both the take-off and landing phases. The knowledge of the main changes in the athlete's technique could help the coach in their training processes.

## Oral Session

### Physiology 9: Elderly

O121J

O121J-1

### Differences in triceps surae muscle strength, volume and specific torque between young and older men

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*Keywords: muscle, aging*

The purpose of this study was to determine whether the age-related decrease in triceps surae muscle strength is due to a loss in muscle size (sarcopenia) alone, or also to a decrease in the ability for older men to fully activate the triceps surae muscle group, leading to a decrease in specific torque.

Ten healthy young men (age:  $24.3 \pm 4.8$  years (range 19-35), height:  $179.8 \pm 8.1$  cm, mass:  $77.3 \pm 13.0$  kg, mean  $\pm$  SD) and 10 healthy older men (age:  $73.3 \pm 3.9$  years (range 70-82), height:  $169.9 \pm 4.6$  cm, mass:  $74.8 \pm 8.1$  kg) volunteered to participate in this study. Triceps surae muscle volume was estimated using a MRI scanner. Plantar flexor maximal voluntary isometric strength (MVC) was measured using a Cybex dynamometer at  $-20^\circ$ ,  $-10^\circ$ ,  $0^\circ$ ,  $10^\circ$ ,  $20^\circ$  and  $30^\circ$  of the ankle joint with the subjects lying prone (knee at  $180^\circ$ ). Specific torque of the triceps surae was calculated as the

ratio between the maximal torque at the optimal angle of  $-20^\circ$  and muscle volume. Supramaximal double electrical pulses were superimposed on MVC and elicited at rest post contraction to determine percent voluntary activation level.

Older men were found to have significantly lower plantar flexor torque at all joint angles than the young males ( $35.7 - 47.5\%$  from  $-20^\circ$  to  $+30^\circ$ ,  $P < 0.01$ ). The muscle volume was 19.3% smaller in the older men compared to the young ( $745.4 \pm 25.5$  cm<sup>3</sup> and  $924.0 \pm 66.3$  cm<sup>3</sup> respectively, mean  $\pm$  SE,  $P = 0.02$ ). As a result specific torque was 20.8% lower in the older men than the young men ( $0.14 \pm 0.01$  vs.  $0.18 \pm 0.01$  N.cm<sup>-2</sup>,  $P = 0.02$ ). Whereas the young males were able to fully activate their triceps surae muscles at all joint angles, the older men had significantly lower activation levels at the angles of  $-20^\circ$  ( $83.4 \pm 3.7$  vs.  $99.9 \pm 0.1\%$ ,  $P < 0.01$ ) and  $-10^\circ$  ( $89.2 \pm 2.8$  vs.  $100.0 \pm 0.0\%$ ,  $P < 0.01$ ).

The present study shows that the 21% difference in plantar flexor specific torque of older men seems largely explained by a reduced ability to fully activate this muscle group.

*Scaglioni et al (2002). J Appl Physiol 92: 2292-2302*

## O121J-2

**Chronic endurance training can delay the onset of age-associated decline in leg strength and muscle morphology**

**Tarpenning Kyle M, Hamilton-Wessler Marianne, Wiswell Robert A, Hawkins Steven A**

Charles Sturt University, Australia

**Keywords:** *endurance training, leg strength, isokinetic moment*

It has been reported that maximal strength peaks at about age-30, then plateaus and remains relatively stable for the next 20 years, with an age-related decline in strength becoming significant during the fifth decade of life. Much of the research attributes this decrease in peak force to age-associated reductions in muscle mass, with a selective atrophy and reduction in Type II fibre area and number being the primary factors. Although a number of investigations have reported the ability of older men to increase muscle size and strength consequently to a resistance training regimen, the influence that endurance training has upon age-associated changes in muscular strength and muscle morphology has been largely undetermined. The purpose of this investigation was to examine the influence of chronic endurance training and age on knee extensor strength, and muscle fibre size and type distribution.

107 male master runners (40-88 yr) were tested for maximal strength of the knee extensor muscles. A sub-group of 30 athletes participated in muscle biopsy testing. The effects of age were addressed by sub-dividing the sample into age groups (by decade) and examining differences.

Peak isokinetic concentric torque did not differ between age groups until after age 70. Regression analysis reveal a significant ( $P < 0.05$ ,  $r^2 = 0.2075$ ) age-associated decrease in relative strength (Nm·kgLBM<sup>-1</sup>). Type I and Type II fibre area and distribution did not differ between age groups through the eight decade.

These data suggest that chronic endurance training can delay the age of onset of significant decrement in peak torque, and muscle morphology characteristics of the vastus lateralis.

## O121J-3

**Effects of two weeks of immobilization on the plantar flexor neuromuscular properties in humans**

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University of Bourgogne, France

**Keywords:** *EMG, m. triceps surae, hypokinesia*

It is well established that reduced physical activity induced by immobilization can lead to a decrease in maximal voluntary contraction (MVC). Few investigations have focused on the effects of short-term immobilization (< 3 weeks) on the triceps surae muscle in able-bodied humans. With another unloading model, Deschenes et al. (2002) have shown that the diminution of muscle strength after 2 wk of unilateral lower limb suspension was associated with decreased EMG activity without alteration of the size and fiber type distribution of the knee extensor muscles. Therefore, it can be supposed that strength losses induced by short-term immobilization (< 3 weeks) would be attributable to neural adaptations rather than muscular alterations.

Twelve male volunteers were divided into two groups: the immobilized group (IG, n=6) and the control group (CG, n=6).

The ankle joint of the right leg was immobilized at 90° by elastic adhesive band and maintained by an ankle stabilization orthosis. Subjects were then fitted with crutches and instructed not to use their immobilized leg during the experimentation. Maximal plantar-flexor was obtained under voluntary and evoked contraction. For the soleus and LG muscles the EMG root mean square (RMS) values were calculated and then normalized to the surface of the respective maximal M wave (i.e., RMS/M ratio).

After immobilization, plantar flexor maximal voluntary torque significantly decreased by 15.9% ( $P < 0.05$ ). Strength losses were accompanied by a significant reduction on maximal tetanic force (14.0%,  $P < 0.05$ ). Furthermore, the soleus RMS/M ratio decreased significantly  $33.7 \pm 9.5\%$  ( $P < 0.05$ ) while no changes were observed for the LG RMS/M ratio after immobilization.

The relative decrement in maximal voluntary plantar flexion torque obtained in the present study (16%) is consistent with those reported by Davies et al (1987). The decrease in plantar flexor MVC observed in the present study was accompanied with a similar impairment of 100 Hz maximal tetanic force (14%). These results suggest that strength reductions are partly associated with changes occurring at the muscle level, i.e., muscular atrophy. EMG activity analysis demonstrated that the mono-articular soleus muscle was more affected than the bi-articular lateralis gastrocnemius muscle after immobilization.

## O121J-4

**Temperature regulation in ageing endurance athletes: a longitudinal study**

**Thompson Martin, Chapman Phillip, White Michael**

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**Keywords:** *thermoregulation, aging, marathon*

There is limited published research on the effects of ageing on thermoregulatory responses to prolonged constant-load exercise. The few reports are cross-sectional in design and as such have inherent biases in terms of subject selection. Experimental isolation of the influence of ageing per se is further thwart with difficulty since core temperature is dependent on the relative exercise intensity (% VO<sub>2</sub> max) while sweat rate is a function of heat load and hence absolute exercise intensity (VO<sub>2</sub>). Contradictory findings suggest that decreased exercise-heat tolerance is either due to a reduced sweating capacity or related to the well-documented reduction in maximal oxygen uptake with ageing.

In the only longitudinal study reported to date, we have investigated the thermoregulatory responses of six well-trained endurance athletes to one-hour of treadmill exercise at 70-74% VO<sub>2</sub> max in thermoneutral environment (Tdb 20.3oC, Twb 15.9oC). The initial prolonged exercise test was conducted in 1979 and the subsequent identical test (same % VO<sub>2</sub> max, Tdb oC and TwboC) was undertaken 23 years later in 2002.

Despite the athletes maintaining regular endurance training over this period there was a significant reduction in maximum heart rate (21 beats/min) and maximum oxygen uptake (21%). However, during the one-hour treadmill exercise a similar rise in rectal temperature, sweat rate and decrease in skin temperature was observed despite a significant difference in the absolute workload. These findings are supported by several cross-sectional studies of thermoregulatory responses of young and older athletes to endurance exercise as reported in the research literature.

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## O121J-5

**Association between training response and cardiac vagal activity in sedentary subjects**

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**Keywords:** heart rate variability, training response, autonomic cardiovascular control

Individual responses to the aerobic training vary from none to 40 % increase in maximal oxygen uptake (VO<sub>2</sub>max). The physiological background for the inter-individual differences is not well known. We tested the hypothesis that the cardiovascular autonomic regulation, measured by heart rate (HR) variability, is associated to the training response in sedentary subjects.

Healthy sedentary subjects (BMI<30) were recruited to the study (n=40, age 41±5 yr, 22 females and 18 males). The training intervention lasted two weeks and included five 40 min sessions each week at 70-80 % of individual maximal HR. The training was performed on a bicycle ergometer in our laboratory, and all the sessions were supervised. Cardiovascular autonomic function was assessed by measuring low (LF 0.04-0.15 Hz) and high frequency (HF 0.15-0.4 Hz) spectral power of HR variability and HR from the 5-min R-R interval recordings at rest and during a passive head-up tilt test (80°). The subjects were divided into a high (change in VO<sub>2</sub>max>4 %, n=28) and low (change in VO<sub>2</sub>max<4 %, n=12) response group after the training. The groups were matched for a baseline VO<sub>2</sub>max, age and gender due to the effects of these variables on the autonomic regulation. In the final analysis, the low response group included 8 subjects (4 males and 4 females, 41±6 yr) and the high response group 8 subjects (4 males and 4 females, 40±6 yr).

After the training, VO<sub>2</sub>max increased 8±7 % in all subjects (range from -5 to +26 %). VO<sub>2</sub>max increased 12±7 % (from 35±4 to 39±6 ml·kg<sup>-1</sup>·min<sup>-1</sup>, p=0.003) in high response group and did not change (0±3 %, from 36±6 to 36±6 ml·kg<sup>-1</sup>·min<sup>-1</sup>, p=ns) in low response group. The mean HR did not differ between the groups at any condition. The mean value of HF power did not differ at baseline but it was significantly higher in high response group compared to low response group at rest (7.1±0.9 vs. 5.8±0.8 ln ms<sup>2</sup>, p=0.024) and during tilting (6.2±1.0 vs. 5.0±0.7 ln ms<sup>2</sup>, p=0.044) after the training. There were no significant differences in LF power or LF/HF ratio between the groups before or after training intervention.

A significant inter-individual difference in the training response is observed among sedentary subjects after the highly controlled short-term aerobic training intervention. The increased cardiac vagal activity, measured by vagally mediated beat-to-beat R-R interval fluctuation (HF power), is associated to the successful training response.

## O121J-6

**Effect of water height on biochemistry and heart rate of horses exercising on a treadmill submerged in water**

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**Keywords:** water-treadmill, lactate, horse

To find the conditions necessary to determine v<sub>4</sub> in horses exercising on a treadmill submerged in water with the maximal attainable speed of 5.5 m/s (v<sub>4</sub> = speed at which a blood lactate concentration of 4 mmol/l is determined under the defined conditions).

In 2 studies 10 adult warmblood horses were submitted to standardized exercise tests (SET) on a treadmill submerged in water. Blood samples were taken from jugular vein immediately after each step of a SET for lactate analysis, and after centrifugation for CK analysis in plasma. Heart rate was monitored with an on-board meter. Results were analyzed using ANOVA for repeated measurements. Study A) Each horse run once a SET with the water at the height of 10 %, 50 % and 80 % of their withers. The SETs consisted of five steps of 5 minutes duration each. Speed of initial step was 3.5 m/s. Thereafter speed was increased by 0.5 m/s in each step. Study B) The SET consisted again of five steps of 5 minutes duration each, but speed was kept constant at 5.5 m/s (maximal!), and water height was varied. It was at 20 % of the withers height in step 1, and at 35 %, 49 %, 63 % and 77 % in the following steps.

Study A) Blood lactate concentration increased until step 3 and thereafter showed a plateau when horses worked at a water height of 10 % and 50 % of their withers height whilst it fell thereafter when horses worked in the water at 80 % of their withers height. Plasma CK activity increased continuously in all horses during all SETs. However, the effect was larger when horses exercised in water at a height of 80 % of their withers. Study B) Blood lactate concentration and plasma CK activity increased during SET until step 3. While blood lactate concentration fell thereafter, CK activity continued to increase.

It seems not possible to determine v<sub>4</sub> in horses exercising on treadmills submerged in water up to a height of 80 % of their withers height. This holds when the maximal speed at which the treadmills can be run is 5.5 m/s. But most commercial treadmills which can be submerged in water are not built for faster speeds.

## Oral Session

### Training and Testing 4

O121K

## O121K-1

#### A comparison of the calculation of work load in water and on land under using an in-water ergometry

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*Keywords: in-water ergometry, estimation of work load, spiroergometry*

The importance of water as therapeutic medium isn't in dispute. The validity of the known physiological relationship between work load and oxygen uptake in consideration of the physical property of water characterize the fundamental problem to determine the work load (WL) in water especially at the medical-therapeutic perspective. The aim of this study is to develop and verify a device which will determine the work load in water based on a mechanical approach.

Seventeen subjects were enrolled in the study and performed an exercise using the cycle-ergometer with gas analysis on land, as well as in the water. To determine the WL in water we used both a physiological approach (PA) and a mechanical approach (MA). The basis of calculation to determine the WL in water based on the MA was both the product of torque and speed of rotation angle and an equation based on the instrument calibration of the trail construction (SCHEGA et al. 2002).

The methodological results in our MA determined that physical activity in water produced an average WL that was  $32.5 \pm 4.89$  Watts higher than those who did not do the activity. In comparison to the PA, we found an additional work load of  $30.9 \pm 3.58$  Watts, respectively. The WL in water characterize a fundamental work load, which is dependent on the medium, the individual anthropometry and the mechanical property of the modified cycle-ergometer to overcome the hydrodynamic resistance of water.

The results of our study prove the validity of the physiological approach to determine the work load in the medium water. Furthermore it is important to consider the additional work load in water during activities, for example for patients with coronary artery disease. A reliable comparison of work load should be examined on closer energetic inspection, especially to determine the overall efficiency.

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## O121K-2

#### A pattern recognition approach for an opponent specific classification of tactical moves in volleyball

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*Keywords: volleyball, tactical moves, pattern recognition*

In the practical methodical literature of team sports it is often supposed that the own tactical behavior should depend on the opponents moves. The aim of this study is to classify specific tactical moves in women's volleyball by means of a pattern recognition approach. Therefore the athletes' space-time-behaviour on the court was examined quantitatively regarding specific classifications of certain tactical moves. The analyzed move was the two player block on position II during defense against attacks from opponents IV.

Data were collected at the 2002 World Championship where matches of the German national team against 5 other national teams were recorded with 4 digital camcorders with 25 fps and a 1/250 shutter. In each set of each match of the German national team, 3 defense moves were analyzed (54 situations altogether). The analysis started when the opponents setter touched the ball and ended when the ball left the hand after the attack. The players heels were digitized and transformed via direct linear transformation (DLT) in order to obtain the space-time-coordinates. The moves were compared to each other on the basis of different proximity and similarity measures. A cluster analysis was used to classify team patterns and determine similarities of tactical behaviors. Both, time continuous and time discrete coordinates of 3 (backcourt) or 6 players were processed, so that starting, end points, differences between the players, and the range of moves as well as the shape of moves could be compared.

Regardless of the chosen proximity or similarity measure, the results show no clusters of moves against similar opponents. Processing time discrete and time continuous data as well as focusing on different players (3 vs. 6) lead to similar results. Likewise, the analysis of the clusters concerning successful defenses or being in the lead did not produce more consistent clusters of the chosen video sequences.

As no opponent specific tactical behavior could be found, the tactical moves of the German national team seem to be more situation specific. Whether these results are due to a highly adaptive defense system (with regard to every single attack) or to a lack of adaptability (with regard to different opponents) requires further research. Furthermore, additional research for comparison with the tactical adaptability of the World Champion (Italy) is demanded.

## O121K-3

**Two weeks of intensive training have no effect on submaximal gas exchange measurements during incremental exercise in competitive cyclists**

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*Keywords: cycling, endurance training, spiroergometry*

Although there is some evidence that endurance training has effects on muscle metabolism and work economy, there is a lack of information about changes in spiroergometric responses to graded exercise after strenuous training programs. Therefore, the present study was conducted to explore the effects of a strictly controlled, intensive training program on respiratory responses to incremental exercise tests.

15 competitive cyclists (24 (4) years, 72 (7) kg, maximal oxygen uptake = 69 (9) ml/min/kg) finished two weeks of intensified training (IT). Training intensities were monitored by means of an ambulatory powermeter (SRM-system). Before and after IT a graded incremental exercise (GXT) test took place. During GXT blood lactate concentrations (La), heart rate (HR), oxygen uptake (VO<sub>2</sub>), carbon dioxide output (VCO<sub>2</sub>), minute ventilation (VE), respiratory exchange ratio (RER), ventilatory equivalent for oxygen (EqO<sub>2</sub>) and carbon dioxide (EqCO<sub>2</sub>), breathing frequency (fB), and tidal volume (VT) were measured during the last 30 seconds of each stage.

No significant differences could be documented between pre- and post-values in all spiroergometric parameters ( $p > 0.05$ ). In contrast, a rightward shift in the La curve ( $p < 0.01$ ) as well as significantly decreased HRs for given power outputs ( $p < 0.05$ ) were observed. The behaviour of La and HR indicates an improvement in the cyclists' performance, but no corresponding effect on gas exchange variables was observed.

Theoretically, influences of intensive training regimens on the submaximal behaviour of oxygen uptake due to changes in work economy or a greater reliance on aerobic metabolism can be expected. Our treatment of two weeks might have been too short to induce such adaptations. Traditionally, a physiological link between blood lactate and respiratory responses to exercise due to bicarbonate buffering is assumed. However, this direct relationship is not supported by the present findings. In summary, this study suggests that submaximal spiroergometric measurements do not yield comparable information to measurements of blood lactate and heart rate.

## O121K-4

**Competitive level, recovery type and blood lactate removal after a judo combat**

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*Keywords: lactate, judo, non-elite*

Blood lactate [LA] has been used to evaluate glycolysis contribution in supramaximal activities where work can not be measured. Judo is a combat sport which relies on anaerobic lactic metabolism (Callister et al, 1991). During combat, judo players with higher technical level are supposed to have lower energetic demand, especially from

the anaerobic lactic metabolism. Moreover, judo athletes compete in several combats on the same day with a short interval time between them (approximately 15-min). Some judo players use active recovery (AR) after fight in order to have a faster [LA] removal. Thus, the objective of this study was to verify if competitive level influence [LA] removal during both AR and passive recovery (PR) after a judo combat.

Twenty-five male adult judo players (10 elite - medallists in Brazilian National or International competitions and 15 nonelite - non medallists in those competitions) were submitted to a treadmill test to the determination of aerobic power (VO<sub>2peak</sub>) and capacity (Anaerobic Threshold; AT). The AT was the velocity corresponding to the 4 mmol.L<sup>-1</sup> (Heck et al., 1985). In two different days, athletes performed a 5-min judo combat, followed by 15-min PR or AR (70% of the AT velocity, @ 50% VO<sub>2peak</sub>), randomly determined. [LA] were measured at rest, 1, 3, 5, 10 and 15 min after each combat. The comparison between situations was done through a three way ANOVA (group, recovery type and time) with repeated measures, followed by Tukey test. The comparison between groups concerning VO<sub>2peak</sub> and AT velocity was done through a one way ANOVA.

There was an effect of competitive level, recovery type and time on [LA]. It was also found an effect of interaction between time and competitive level and between time and recovery type. [LA] was lower after combat in elite compared to nonelite judo players, during AR compared to PR and as expected decreased over time. The interactions showed that the differences in [LA] between elite and nonelite groups decreased over recovery time. The opposite was observed between AR and PR.

The difference between elite and nonelite judo players can not be attributed to the aerobic power or capacity because the groups were similar in both variables. A possible explanation for this difference can be a lower glycolytic activation due to a higher technical level in elite compared to nonelite.

Callister et al (1991). *Int J Sports Med* 12: 196-203.

Heck et al (1985). *Int J Sports Med* 6: 117-130.

## O121K-5

**The role of the generalized motor program and forward modeling at the control of quick discrete movement**

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*Keywords: generalized motor program, feed-forward, forward model, inverse model*

In the last decade numerous theories in connection with motor learning and motor control (Richard A. Schmidt, Kawato, Gomi) appeared. In these theories the concept of motor program is used to interpret the preparation and initiation of quick, discrete movements. According to the given theories the process of motor learning is interpreted as general rule learning. This article emphasizes the role of the generalized motor program and forward modeling, in the framework of the movement analysis of a quick, discrete task. The subjects were asked to make a quick extension-flexion movement in their elbow joint using their palm to generate a vacuum to blow out a candle without any direct contact with the flame. The experimental order and the quick execution of the movement assured to analyze the connection between the generalized motor program and the forward model. 6 sport university students participated in this experiment. Their age was between 22-27 years and all of them were active sportsmen. On one hand the aim of this experiment is to



determine the successful movement execution criterias with a movement analysis technique and on the other hand to work out a measurement method that indicates the relation between the generalized motor program and the forward model.

Our hypothesis is that successful movement execution depends on the precise anticipation of the required movement parameters, and based on the provided parameters the movement will be executed by the generalized motor program. Based on our results the main criterion of the successful execution is the wrist joint timing during the movement. It indicates that the selection of the right generalized motor program was correct but the forward model was not able to provide the correct parameters in connection with timing of the wrist joint and the movement dynamics.

O121K-6

### **Assessment and rehabilitation program of plantar fasciitis in female handball players**

**Traistaru Rodica, Rusu Ligia, Poenaru Daniela**

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*Keywords: plantar fasciitis, rehabilitation, handball*

Our study was undertaken to investigate the role of clinical and ultrasonography of calcanean (ultrasound bone densitometry and image report moderated) assessment and rehabilitation program in handball woman players who were diagnosed with PF.

The study was carried out in the Department of Sports Medicine of University of Craiova, in 2002. We took into consideration two groups of 12 female handball players: the PF group (group A,) and the control group (group B) without PF. All subjects were evaluated at entry into the study (Time 1), after 4 weeks of rehabilitation (Time 2). We obtained data for diagnostic criterions by clinical, laboratory methods, soft tissues sonography (using a Siemens scanner with a 7,5 MHz linear array transducer) and ultrasound bone densitometry (using UBIS 5000).

The pain intensity was measured with visual analogue scale VAS (0 - 10). SIP (Sickness Impact Profile) scale was used for assessment of quality of life. The rehabilitation program was complex (physical-kinetic and pharmacological).

After 3 - 4 weeks treatment, all clinical parameters taken into consideration for experimental group were normal (movements functions - joint mobility and muscle strength, special tests) and the mean scores values (VAS score and SIP score) improved significantly. The mean scores of SIP at Time 2 were better (SIP=3,4, SD=1,6) than the mean scores at Time 1 (SIP=18,4, SD=8,2) The normality of echogenicity and muscle fibrillar pattern, of tendon diameter on sonograms were obtained at weeks after initial evaluation, but the ultrasound bone densitometry image remained unchanged for 6 weeks. BUA was greater than BUA Osteopenia (the mean value was 65.0 dB / MHz).

We concluded that handball players with plantar fasciitis must complete (pathologic - clinic - imaging - functional) evaluation and return to training and competition after the healing and rehabilitation process is completed. Objective and consistent criteria for return to play can be established if all the complexes (tissue overload, tissue injury, clinical symptoms, dysfunction, subclinical adaptations) have been resolved.

Increased flexibility of the triceps sural is one of the most important kinetic aspects in rehabilitation of PF.

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## Symposium

### Exercise Performance at Moderate Altitudes in Health and Disease

S122A

## S122A-1

#### Exercise performance for mountaineering: How much is necessary?

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Keywords: *performance, mountaineering*

In recent years mountainous areas have attracted an increasing number of persons all over the world. In Austria alone, more than 10 million hikers and skiers annually visit moderate altitudes. That number may exceed 40 million for the whole Alps, and it is assumed that there are about 100 million mountain tourists worldwide (1). Many of these tourists, however, are not aware of the fact that mountain sport activities demand a relatively high degree of physical fitness and that the risk of injury and death increases when fitness is insufficient.

Energy costs are relatively low when walking or even running on horizontal paths, however, they increase markedly when moving uphill in the mountains.2,3 An altitude gain of 300 m per hour on average is assumed for calculation of normal ascending times to alpine huts and summits on marked paths. The corresponding energy expenditure can be predicted by combining the findings of Minetti (2) and Laursen et al.(3): Oxygen consumption (ml/min/kg) =  $[0.133 \cdot \text{horizontal distance (m)} + 2.0 \cdot \text{vertical distance (m)}] / \text{time (min)} + 3.5$ . Example:  $[0.133 \cdot 2000 + 2.0 \cdot 300] / 60 + 3.5 = 17.9$  mlO<sub>2</sub>/min/kg.

This reveals that an average oxygen consumption of about 18 ml/min/kg is needed to climb 300 m per hour in altitude with an optimal gradient of 15 %,2 with only a small additional load, and an average work efficiency. Since prolonged work can be performed at not higher than 60 % of maximal oxygen consumption (VO<sub>2</sub>max), a minimum VO<sub>2</sub>max of 30 ml/min/kg (8.6 METs) must be attainable. If VO<sub>2</sub>max measurement is not available it can be calculated from the maximum power (Pmax, watt/kg) achieved during cycle ergometry: VO<sub>2</sub>max (ml/min/kg) =  $10.2 \cdot P_{\text{max}} + 3.5$ . Considering that VO<sub>2</sub>max declines at the rate of 1 % per 100 m altitude gain above 1500 m, these values have to be increased by 15 % when mountaineering at 3000 m (VO<sub>2</sub>max at sea level: 34.5 ml/min/kg). Carrying a heavy rucksack or heavy footwear and using more difficult paths would increase these requirements.

Thus, endurance capacity may well be a limiting factor for untrained mountaineers, however, it can be easily improved by endurance training. Whereas a relatively high degree of aerobic capacity is necessary to perform mountaineering activities safely and enjoyably, mountaineering per se will contribute to the improvement of physical fitness.

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2 Minetti AE. *J Appl Physiol* 1995; 79:1698-703.

3 Laursen B et al. *Applied Ergonomics* 2000; 31:159-66.

## S122A-2

#### Exercise performance at high altitude: mind over matter?

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Keywords: *performance, exhaustion, brain*

Classically the limit to exercise endurance is set by cardio-respiratory capacity and muscle fatigue. This paradigm cannot explain cessation of whole body endurance exercise at high altitude when subjects stop with less muscle fatigue and with sub-maximal cardiac output. What explains exhaustion at high altitude? Voluntary exercise starts and ends in the brain. It starts with spatial and temporal recruitment of motorunits and ends with de-recruitment. A conscious decision precedes a voluntary effort. The end of effort is again volitional and a (forced) conscious decision precedes it. An example is an incremental exercise test when the subject indicates to be unable to continue and has to stop.

The obligatory decision to stop is conscious, thus likely occurs at cortical levels, probably forced by sub-cortical brain circuitry. Taking further a hypothesis by Hill (1924), Noakes proposed a 'central governor' preventing muscle recruitment beyond levels of intensity and duration to protect the heart or other vital organs (Noakes 2001). Interpreting data from a simulated climb of MtEverest, Bigland-Ritchie and Vollestad (1988) proposed CNS limitation of performance at altitude. Kayser (1994) found small muscle mass dynamic exercise capacity unchanged at altitude, whereas large muscle group exercise capacity was reduced, with sub-maximal cardiac output and no muscle fatigue. It is unknown what switches off recruitment at exhaustion from large muscle exercise at altitude, potential contenders are the respiratory system, taxed more for a given performance (Cibella 1999), and brain oxygen saturation, shown to drop at maximal cycling (Imray 2003).

Thus, volitional exhaustion does not necessarily coincide with reaching metabolic capacity. Exercise at altitude is an example when cessation of exercise is determined by other factors than classic metabolic fatigue and maximum cardio-respiratory performance. Other input to the CNS eventually leads to de-recruitment of motorunits. The proposed scheme remains speculative and must be tested. It is adequate to quote from the early Hill paper (1924) in which the notion of a governor was proposed: 'We realise the danger of a hypothesis partly suggested by teleological reasoning; in this case, however, we can see no other explanations of our experimental results.' I believe this viewpoint still stands and it is time to design research protocols that test the hypothesis of a central governor limiting exercise performance.

## S122A-3

**Mountain sports and cardiac diseases**

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University of Padua, Italy

**Keywords:** *rehabilitation, moderate altitude, cardiac diseases*

Even today, a restrictive attitude frequently leads the physician to discourage the patient with cardiovascular abnormalities from sojourn at altitude over 1000 m. This attitude, however, is not supported by any scientific proof. After a review of the major cardiovascular adaptations during high altitude exposure, we report the principal studies of the effects of high altitude on patients with coronary heart disease, particularly during exercise.

On the basis of personal experience and of other authors, we can state that the patient with ischemic heart disease, asymptomatic and with a recent clinical and functional evaluation, can stay in the mountains, even at altitudes of 2000-3000 m, and can hike and ski (cross-country and downhill). The risks appear to be related to factors independent of altitude, such as excessive cold or intense emotional stress due to dangerous situations, conditions that must consequently be avoided.

On the other hand, an individual approach should be followed for the other congenital and acquired heart diseases, in which case we must consider, in addition to the clinical situation, some peculiar aspects of mountain environment (hypoxia, isolation, difficult access to medical facilities).

Finally, the hypertensive patient, expected to present higher blood pressure values, especially diastolic, should frequently record his values during the first week at altitude, eventually adjusting the therapy.

diseases, even the other environmental characteristics can play an important role: the reduced air density which contributes to the improvement of the flow- volume curve parameters; the reduction in the atmospheric humidity which modifies the osmolarity of the bronchial fluid; the increase of windy conditions and the cold which may induce asthma attack; the reduction or even the absence, of allergens and of atmospheric pollutants.

#### 1. Asthma and bronchial hyper-responsiveness

The mountain climate can modify respiratory function and bronchial responsiveness of asthmatic subjects. Hypoxia, hyperventilation of cold and dry air and physical exertion may worsen asthma or enhance bronchial hyperresponsiveness while a reduction in pollen and pollution may play an important role in reducing bronchial inflammation. At moderate altitude the main effect is the absence of allergen and pollutants. At very high altitude a reduction in bronchial response has been shown probably related to the protective role of the higher levels of cortisol and catecholamines. Data about asthmatic patients at altitude between 2000 and 3500m are lacking. Some recommendations for the exposure of asthmatics to high altitude will be given.

#### 2. Chronic obstructive pulmonary diseases (COPD)

Patients with mild airway obstructions can take advantage of the lower density of the inhaled air and can stay at moderate altitude. However, in the presence of exacerbations, the exposure to altitudes should be avoided.

#### 3. Respiratory diseases with hypoxemia

The evaluation of patients who are already hypoxemic at sea level is more complex.

These patients can be at 2000 m in the same conditions in which healthy subjects are at 4000 m. We must keep in mind, for example, that at 2500 m, the reduction in oxygen level in the inspired air is about 23%. It is important to predict the level of hypoxia that a subject may encounter when is exposed to a hypoxic environment. Although each patient should be analysed separately, there is a general limit to the tolerance to high altitudes. The values for certain parameters below which the exposure to environmental hypoxia is absolutely contraindicated in the absence of supplementary oxygen will be discussed. In the case where exposure to hypoxia is absolutely unavoidable (e.g. if one must fly), additional oxygen supply must be considered.

## S122A-4

**Mountain and respiratory diseases**

**Cogo Annalisa**

University of Ferrara, Italy

**Keywords:** *altitude, asthma, COPD*

Hypobaric and hypoxia are the most important atmospheric elements at high altitudes, but in patients with respiratory

**Oral Session****Physiology 10****O122B**

## O122B-1

**Longitudinal behaviour and influence of training on serum urea and creatine kinase in distance runners**

**Niessen Margot, Hartmann Ulrich, Schulz Henry, Heck Hermann, Grabow Volker, Platen Petra**

Technical University of Munich, Faculty of Sport Science, Germany

**Keywords:** *distance running, metabolic stress symptoms, longitudinal variability*

Serum creatine kinase (CK (U/l)) and urea (SU (mmol/l)) are often used to detect induced muscular stress and catabolic protein degradation due to extent and / or intensive training regimes. The aim of this study was the investigation of

longitudinal behaviour, influence of training on CK & SU and their inter- & intra-individual variability.

For the longitudinal aspect we observed 3 male (m) (26,3±6,1y; 179,7±0,6cm; 70,0±5,3kg) and 2 female (f) (24,0±2,8y; 173,5±0,7cm; 56,9±0,4kg) elite distance runners (DR) 1 (n=5) up to 2 (n=3) years. All underwent 1-3 ear-capillary blood-samplings (postabsorptive state; morning) per week. CK & SU were determined out of 20µl serum by Cobas-Bio®.

The mean values, including outliers (O) and extremes (E) (median±25%+(coefficient: 1.5 O; 3 E)· 50%), were 124.9±93.4U/l CK & 6.3±1.2mmol/l SU in m DR1-3 and 121.5±287.5U/l CK & 5.3±1.1mmol/l SU in f DR4-5. Frequency distribution: 2.3% CK > 300U/l & 3.6% SU > 8mmol/l in m and 1.4% CK > 300U/l & 3.8 % SU > 7mmol/l in f. Longitudinal variation: 84.1±79.5% CK & 18.9±3.7% SU. E-values: 4000U/l CK and 10.7mmol/l SU. The range of average amount of overall training loads were: 68km/5h-

247km/16h per week. The range of av. intensity of running units per day was: 74-80%v4 of velocity at 4mmol/l lactate. Inter-correlation of CK with SU showed significant coherences for DR1 ( $p<0.001$ ) and DR5 ( $p<0.05$ ), sig. negative corr. between CK resp. SU and hematocrit (Hct) ( $p<0.05$ ) for DR4 and no sig. diff. between two years (DR1, 4-5). A cross-correlation of training with CK showed significant coherences for Lag(L)1-L1-3 (DR1, 3) and L1-L1-6 (DR2). For SU: sig. positive (DR1, 4) and negative (DR5) inter-relations for L1-L1-6 were observed. DR displayed av. CK-/SU-values within normal ranges, but with inter-individual different variability. DR1 and DR5 had the greatest variation coefficient and the highest measured values in conjunction with peak av. running intensity (%v4) (DR1, 5) and peak amount of overall training (DR5). Independent to the parameter's level rising CK was detected immediately (L1) following competitions with high intensity (DR1) or long duration (DR5).

The sig. relation of SU and Hct (DR4) assumed dependency to fluid balance. Running specific training tends to increase CK, non-specific to decrease SU. In summary there exist inter-individual oscillations (either frequency or amplitude) of CK and inter- & intra-individual reactions of CK and SU due to overall training loads.

Hartmann H, Mester J (2000). *Med Sci Sports Exerc* 32 (1): 209-215

Hortobagyi T, Denahan T (1989). *Int J Sports Med* 10: 69-89

### O122B-2

#### **Hypertrophic heavy resistance exercise performed with high volume and short recovery versus high intensity and long recovery: Acute hormonal responses**

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**Keywords:** resistance exercise, hormonal responses, neuromuscular fatigue

Heavy resistance exercise has been shown to induce acute hormone responses, which are dependent on the type of exercise protocol, i.e. number of sets and repetitions per set, length of rest periods between sets and muscle mass involved (e.g. Häkkinen & Pakarinen 1993). For maximal muscle hypertrophy it has been generally recommended to use multiple sets and short rest periods (i.e. 60-90 sec.) between the sets. However, training protocols emphasizing higher intensity/lower volume with longer rest periods between the sets have also been recommended in bodybuilding magazines. The present study investigated acute hormonal and neuromuscular responses and recovery to the hypertrophic type of heavy resistance exercises performed with a higher volume and shorter rest periods between the sets in comparison to that of a higher intensity and longer rest periods between the sets.

Subjects: twenty strength trained men. Loading protocols: high volume/short rest (HV) and high intensity/long rest (HI) periods between the sets. HV included 5 sets of leg presses and 4 sets of squats (with 10RM) with a 2-minute recovery between the sets and 4 minutes between the exercises. HI included 4 sets of leg presses and 3 sets of squats (with 10RM) with a 5-minute recovery between the sets and 4 minutes between the exercises. The loading was assessed so that total load (load x sets x reps) in both protocols would be as identical as possible. Measurements: serum total and free testosterone, cortisol and growth hormone (GH), blood

lactate, maximal isometric leg extension force and EMG activity.

Significant decreases ( $p<0.001$ ) occurred in isometric force and in EMG activity ( $p<0.05$ ) and increases in blood lactate concentrations ( $p<0.001$ ) in both loading protocols. Serum testosterone, free testosterone, cortisol and GH concentrations increased ( $p<0.001$ ) in both protocols. There were no statistically significant differences in physiological variables between the HV and HI loadings, except for post 15 minutes in cortisol responses ( $p<0.05$ ). The present study showed no differences between the HV and HI loading protocols.

The results indicate that when the training intensity is kept high, fewer sets and longer rest periods between the sets produce similar acute hormonal responses than heavy resistance exercise performed with higher volume and shorter rest between the sets.

Häkkinen K, Pakarinen A (1993). *J Appl Physiol* 74: 882-7

### O122B-3

#### **24 days live high-train low increases red cell volume, running performance and VO2max in swiss national team orienteers**

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**Keywords:** athletes, hypoxia, altitude training

The concept of live high train low (LHTL) to enhance hematological parameters for improving sea level endurance performance remains controversial. This possibly results from different "doses" of hypoxia and methods to estimate red cell volume (RCV). Interestingly, most studies using the Evans blue dye technique showed an increase in RCV while with one exception studies using the CO-rebreathing method did not increase RCV. The aim of this study was to determine the effect of 24 days LHTL on RCV, Hbmass (using CO-rebreathing technique), running performance and maximal oxygen uptake (VO2max) in highly endurance trained athletes.

Ten iron supplemented Swiss National Team Orienteers (5 females and 5 males) lived for 24 days at an altitude of 2456m (approximately 18h per day), performed base training (1-2 times per day) at 1800m and interval training (2 times per week) at 1000m above sea level. This "dose" of LHTL has previously been shown to increase RCV (Evans blue dye technique), VO2max and decrease 5000m running time. Pre altitude (-2 days) and post altitude (+ 8 days), we measured VO2max on a treadmill, 5000m running time, RCV and Hbmass. In a pilot investigation ( $n=12$ ), the coefficient of variation was 2.2% for RCV and 1.7% for Hbmass. Results are presented as means  $\pm$  SD.

RCV increased (females:  $1818 \pm 226$  vs  $1891 \pm 171$  ml; males:  $2881 \pm 309$  vs  $3049 \pm 305$  ml;  $p<0.001$ ), as well as Hbmass ( $617 \pm 58$  vs  $646 \pm 52$  g;  $991 \pm 95$  vs  $1052 \pm 95$  g;  $p<0.001$ ) and VO2max ( $50.8 \pm 2.1$  vs  $54.5 \pm 2.8$  ml/kg/min;  $62.3 \pm 5.2$  vs  $63.8 \pm 5.5$  ml/kg/min;  $p<0.05$ ), while 5000m running time decreased ( $1177.3 \pm 44.7$  vs  $1154.2 \pm 43.3$  sec;  $1000.7 \pm 57.7$  vs  $988.4 \pm 51.6$  sec;  $p<0.01$ ) from pre- to post altitude. The increase in Hbmass correlated with the increase in VO2max (females:  $r = 0.75$ ; males:  $r = 0.67$ ).

The LHTL camp increased RCV (5.2%) and Hbmass (5.5%), which contributed to an increased VO2max (4.5%) and improved 5000m running time (-18.3  $\pm$  14 sec). Our study is one of very few to show an increase in RCV and Hbmass after a LHTL camp estimated with the CO-rebreathing method. The data suggests that 24 days living at 2500m and

training at 1800m and 1000m is an adequate "dose" of hypoxia to increase RCV and Hbmass. These changes can be monitored with the CO-rebreathing technique. LHTL enhances sea level performance of elite endurance trained athletes in a relevant size.

#### O122B-4

### Response of acute phase proteins to an ultra-marathon

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**Keywords:** exercise immunology, acute phase response, CRP

In response to a wide range of homeostatic disturbances, the organism initiates an acute phase response (APR). This complex series of reactions serves to activate repair processes and prevent ongoing tissue damage. There still remain a large number of acute phase reactants that have not been thoroughly investigated. The aims of this study were to validate the reported increases in CRP, and to monitor alterations in less researched acute phase reactants after an ultra-marathon.

Venipunctures were performed and serum was stored at -80°C until analysis. The N Latex CRP kit was used to assess CRP levels in serum. Circulating immune complexes (CIC) levels were determined by particle enhanced nephelometry. Determination of complement proteins C3 and C4 were performed using specific anti-sera to C3c and C4. The immune complexes formed were measured in a nephelometer. C6 and Factor B were determined by radial immunodiffusion. Data was analysed using an ANOVA comparing values to pre-exercise levels.

CRP was significantly elevated ( $p < 0.05$ ) IPE, 3 h post, 24 h post (peak) and 72 h post. C6 was significantly elevated ( $p < 0.05$ ) at 24 h post (7.8%) and 72 h post (8.8%) exercise. Factor B was significantly elevated ( $p < 0.05$ ) at 72 h post exercise (12.8%). Rheumatoid factor (RF) was significantly elevated at 72 h post exercise (6.7%).

Peak CRP was obtained 24 h post and remained significantly elevated up to 72 h post exercise. Interestingly, membrane-attack protein C6 was significantly elevated at 24 h and 72 h post exercise whilst the auto-antibody rheumatoid factor (RF) and Factor B, a C3 convertase within the alternative pathway of complement, were significantly elevated at 72 h post exercise. RF contributes to the clearance of immune complexes and thus could be an indication of when the immune-inflammatory response is resolving. These results suggest that certain acute phase reactants manifest several days after the termination of the event.

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*Fallon KE (2001). Clin J Sport Med 11(1): 38-43*

*Wadee A et al (2002). Hum Psychopharmacol Clin Exp 17: 175-179*

#### O122B-5

### Sweat-, urine- and electrolyte excretions of swimmers at different performance levels - training in water temperatures of 24, 26 and 28°C

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**Keywords:** swimming, salt-water-balance, water temperature

The aim of the present study was to investigate reactions of sweat-, urine and electrolyte excretions during swimming training depend on different water temperatures (WT). It was calculated if results depend on training status of the subjects. With 42 male and female swimmers of different performance levels sweat loss as well as diuresis and renal electrolyte excretions were measured during swimming training in WT of 24, 26 and 28°C, respectively. An extensive interval training lasting one hour (distance of 1800-2700 m) was executed dependent on training status of the subjects.

Means of sweat loss increased significantly with WT: 24°C: 220 ml; 26°C: 310 ml; 28°C: 510 ml. For well-trained subjects, whose training intensity was the greatest, sweat loss was the highest. In water of 28°C they reached individual values of more than 1000 ml. Here the urine excretions generally decreased from 1.5 ml/min (24°C) to 1.1 ml/min in WT of 28°C. Sodium excretions did not differ significantly during the three tests, although mean values were the lowest in water of 28°C. In potassium excretions no differences could be discerned.

Generally well-trained subjects displayed a smaller urine and sodium excretion ( $p < 0.05$ ) than lower trained subjects, a fact corresponding to former results before and during 4 h head-out immersion in thermoneutral water without exercise (Skipka et al. 1979). The results show that there are more noticeable quantities of sweat loss in higher WT. Obviously these losses of water and sodium are in part renally compensated for in well-trained subjects.

*Skipka W et al (1979). Eur J Appl Physiol 42: 255-261*

#### O122B-6

### Relationship between ghrelin, resistin and leptin with subcutaneous fat patterning in physically active and sedentary children

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**Keywords:** children, ghrelin, leptin

Ghrelin causes weight gain by increasing food intake and reducing fat utilization whereas the adipocyte-derived hormone leptin exerts the opposite effects. Resistin is another adipocyte-derived factor which might play a role in the pathogenesis of insulin resistance. Because regular physical activity enhances insulin sensitivity, modulates the expression of leptin, and lowers adiposity, we studied the relationship between leptin, ghrelin and resistin with subcutaneous fatness in children.

47 children were studied. On the basis of tests for the physical performance 18 children were considered as physically active (PA). 29 children were considered as not physically active (NA). Blood samples were taken after an overnight fast and determined for leptin, ghrelin and resistin by means of RIA. To assess subcutaneous fatness, the thickness (in mm) of 15 different subcutaneous fatty layers was measured by means of the optical device Lipometer.

PA-children were of significantly smaller stature, had less body mass and had smaller values for 10 out of 15 SAT-layers (all  $p < 0.05$ ). A factor analysis for the 15 SAT-layers showed that two factors (F1: upper body fatness, F2: extremity fatness) exist. Subcutaneous adipose tissue (SAT) was calculated. Values for SAT and F1 were lower in PA-children. Leptin ( $p = 0.11$ ) and resistin ( $p = 0.47$ ) were not different between groups but ghrelin levels were higher in PA-children ( $p = 0.04$ ). In all children, ghrelin was significantly and inversely related to body mass, F1, F2, SAT and also to leptin ( $p = 0.03$ ). Leptin was strongly associated with F1 ( $p < 0.0001$ ) but resistin was only related to the height of children ( $p = 0.03$ ). In PA-children but not in NA-children, the negative relationship between leptin and ghrelin ( $p = 0.06$ ) tended to be of significance. Leptin also tended to be negatively related to resistin ( $p = 0.055$ ) in PA-children. Ghrelin ( $r = -0.42$ ,  $p < 0.05$ ) and resistin ( $r = -0.48$ ,  $p = 0.026$ ) were inversely correlated with F2 in PA-children. In NA-children, ghrelin was in negative relationship to body mass, height, and F1. This study shows that ghrelin levels are higher in PA-children perhaps attributable to I) their greater energy expenditure, II) their need for a higher energy intake and III) their reduced fatness. It is likely that a sufficient energy turnover is necessary to maintain a sensitive ghrelin-leptin axis during growth.

The question whether there is an independent role of physical activity on the regulation of energy intake by modulating the expression rate of ghrelin and leptin has to be investigated in upcoming studies.

#### O122B-7

### Hemodynamic and neuro-hormonal responses to lower body negative pressure (LBNP) following 6 weeks of moderate endurance training

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**Keywords:** training, hormones, orthostatic tolerance

There are contradictory opinions concerning orthostatic tolerance in aerobically fit subjects and their cardiovascular

responses to gravitational stimuli, such as active posture change, head-up tilt or LBNP. Among neural and endocrine mechanisms contributing to orthostatic tolerance the main role is ascribed to activation of renin-angiotensin system. The present study was designed to investigate whether endurance training affects neuro-hormonal responses to LBNP, which induces body fluid redistribution from upper body to lower extremities and is a recognized method to mimic effects of gravity.

Twenty-four healthy male volunteers ( $21.0 \pm 1.0$  yrs,  $74.3 \pm 7.1$  kg,  $VO_{2max}$ :  $47.1 \pm 4.3$  ml/kg/min) participated in this study. Before and after 6 weeks of endurance training (1h daily, 5 days/week), they underwent serial exposures to LBNP at -15, -30 and -50 mmHg for 10 min each or until onset of presyncopal symptoms. To evaluate exercise capacity  $VO_{2max}$  was measured before and after training. During LBNP, heart rate (HR), systolic (SBP) and diastolic (DBP) blood pressure, stroke volume (SV) and cardiac output (CO) were determined. Total peripheral resistance (TPR) was calculated. Plasma renin activity (PRA), norepinephrine (NE), epinephrine (E), atrial natriuretic peptide (ANP), ACTH and adrenomedullin (ADM) were determined before and at the end of LBNP.

Maximum oxygen uptake increased during training by 10.6% ( $p < 0.001$ ). Before training 13 subjects completed LBNP test while 11 exhibited presyncopal symptoms at -30 or -50 mmHg. Training caused improvement in LBNP tolerance in 6 out of 11 subjects. In the whole group the decrease in SBP during LBNP was less pronounced ( $p < 0.05$ ) after than before training whilst the other cardiovascular responses did not differ significantly. Plasma NE, E, ACTH, ADM and PRA significantly increased while plasma ANP decreased during LBNP. Increases in ACTH and ADM were reduced ( $p < 0.05$ ), and an increase in NE tended to be greater in trained subjects.

The present data indicate that moderate training may improve cardiovascular responses to gravitational stress. We did not find, however, any relationships between hemodynamic responses to LBNP before and after training and changes in PRA, catecholamines and other vasoactive hormones.

## Oral Session

### Training and Testing 5: Vibration

#### O122C

#### O122C-1

### Safety considerations in vibration training

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**Keywords:** training, vibration, safety

Although the intensities of vibration training (i.e. frequency, amplitude and training duration) are not yet well-known, vibrations are used in many sports at different levels of performance in order to improve strength and flexibility. Therefore, as a basis for the proper use of vibration training, it is important to get safety guidelines for training comparable to ISO 2631. A general problem with vibrations is that they cannot be clearly restricted to the target muscles, but are

transmitted to other areas of the body. Of special interest here is the vibration load on the brain, since it is generally accepted that this part of the body should be protected in order to avoid various sincere consequences.

The investigation took place on the Galileo 2000 vibratory machine. 30 sport students got the task to dampen vibrations with 2.5 mm amplitude at increasing frequencies (5-10-15-20-25 Hz) to their maximum. While standing on the vibratory platform they were loaded with a barbell weighing about 30% of the individual body weight. The duration of the single steps were 30 s each with 60 s pause between sets. Muscular activities were measured by EMG for the m. vastus medialis, the m. biceps femoris, the m. tibialis anterior and the m. gastrocnemius. In addition to this, accelerometers were placed at the vibration platform and the head in order to

calculate the transmission factors from the platform to the head.

The results show that lower frequencies mean high transmission factors to the head which should generally be avoided since they can cause sensory mismatch and nausea. Their decrease at higher frequencies can be interpreted as the effort of the body to dampen the vibrations in order to protect the brain.

Vibratory thresholds cannot definitely be confirmed as there are many individual deviations from a clear pattern. These individual differences also include at least partly very high coordinative demands during vibration training which need a good preparation esp. in spare time and fitness sport *Spitzenpfeil P (2000). Vibrationsbelastungen im alpinen Skirennlauf: Analyse – Simulation – Training, Dissertation Griffin R (1994). Handbook of Human Vibration, Second Printing, London*

#### O122C-2

### Does acute high intensity vibration training induce leg edema formation?

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*Keywords: vibration training, edema, fluid accumulation*

High intensity vibration exercise is suggested to induce an increase in cutaneous blood flow and edema formation. Recently, different training devices have been implemented on the basis of high frequency vibration. However, at present no studies have been performed using commercial training devices in order to clarify whether edema are regularly seen after training. The aim of our study was to evaluate possible leg fluid accumulation after high intensity training with the Power-Plate whole body vibration.

10 healthy trained volunteers (mean age  $30 \pm 6$  yrs) participated in the study. The single circuit training session consisted of 2 exercise circuits, each with 5 static leg strength exercises, under vibration (frequency 50 Hz, amplitude 4 mm), lasted 1 min per exercise with 1 min rest in between and 2 min recovery between the circuits. Measurement of leg edema formation by two different methods: a) Plethysmographic measurements using an optoelectronic scanner system (Perometer<sup>®</sup>) b) ultrasound sonography (10-25 MHz) for estimating the distance between skin surface and bone at 3 points along the lower limb to get information about tissue layer thickness. Data collection: Immediately before (T1) and after training (T2) as well as 20 min after termination of the training (T3). Statistical Methods: ANOVA for repeated measures.  $P < 0.05$  was considered for statistical significance. Data are shown as mean values  $\pm$  SD. Data of both legs were pooled.

Perometer<sup>®</sup> results: Significant increases were found in thigh volume at T2 (+97 ml, SD $\pm$ 65 ml) and T3 (+50 ml, SD $\pm$ 39 ml). In contrast, volume of the lower leg remained unchanged. Ultrasound sonography: There were no statistical differences in tissue thickness in the lower leg between T2-T1 and T3-T1 as measured at 3 different points. High intensity vibration training induces a certain degree of fluid accumulation in the leg. Fluid was mainly distributed in the thigh and could be measured even 20 min after training termination. However, the intensity of the training bout was beyond that accomplished by the manufacturer for a regular training program. Whether the increase in thigh volume is the consequence of edema formation or vascular overperfusion remains to be investigated.

#### O122C-3

### Hydrodynamic analysis for the effects of whole-body vibration on blood circulation

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*Keywords: body vibrations, blood circulation, shear stress*

Human body experiences vibrations in many sports, under certain working conditions as well as during strength training in terms of vibrating facilities. The present study provides a hydrodynamic analysis for the effects of body vibrations on blood circulation and their possible physiological implications. For a given blood vessel, the lateral component of vibration will only cause lateral oscillatory pressure gradient, while the longitudinal component of the vibration will cause longitudinal oscillatory flow. Detailed solution of the flow perturbation is carried out based on Navier-Stokes equations. The shear stress perturbation can then be calculated. It is found that the peak shear stress at the wall of the vessel can be considerably increased due to vibrations. Two physiological effects of potential danger are discussed: (1) The increased peak shear stress may increase the possibility of causing endothelial cell damage, e.g. in the diseased coronary arteries. (2) The lateral oscillatory pressure gradient may destroy the cell-free perivascular plasma layer in the microvessels of diameters of 10 to 25  $\mu$ m, leading to an increase of the resistance against the blood flow in these microvessels.

The present investigation suggests that more caution should be given to strength training in terms of body vibrations in spite of the potential benefits of such training as claimed by some researchers. The frequency, amplitude and the exposure time should be carefully designed in order to avoid the potential dangers.

#### O122C-4

### Changes in muscle mass of high performance athletes detected by MRI, after a training with different training frequencies

**Wirth Klaus, Atzor Klaus, Schmidtbleicher Dietmar**

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*Keywords: strength training, hypertrophy, training frequency*

In a lot of sports muscle strength represents the basic element of high performance. Besides the neuronal activation muscle mass represents the most important factor that - in long term - influences maximum strength. To achieve the optimum in the development of muscle mass it is very important to provide the muscle tissue with sufficient time of regeneration. One of the consequences is that, besides set and repetition number, the training frequency poses a main question concerning the optimization and planning of programs to develop muscle mass (MM).

30 male subjects with several years of training experience participated in this study of strength training. The subjects were divided into three groups of 10 persons each, who had to go through a hypertrophy training program for arm bends with a frequency of one (G1), two (G2) and three (G3) training sessions per week for up to eight weeks altogether. The training program consisted of five sets with a three minute rest between each. Every set was carried out to muscle failure. The weights to be lifted were chosen in such a manner that a minimum of eight and a maximum of twelve repetitions per set could be carried out. If the test person was able to fulfill twelve repetitions, more weight was added in the next training session. The training cycle lasts eight

weeks. Muscle mass was tested before training and fourteen days after the last training session. Elbow flexors size was determined using magnetic resonance imaging (MRI). The statistical handling of the data consisted of an analysis of variance (with a repetition of the measurements) and the Scheffé-test ( $p < 0,05$ ) as a post-hoc test to check the differences between the three groups with respect to the development of maximum strength.

In the course of this study there was a significant increase in muscle mass in the groups with two and three training sessions a week. From the first to the last testing there was a mean change in muscle size of 2,5% in group G1, 4,6% in group G2 ( $p < 0,05$ ) and 6,3 % in group G3 ( $p < 0,01$ ). The further statistical analysis presented no significant difference between the three groups.

### O122C-5

#### Speed specificity in sprint training

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*Keywords: training, speed specificity, sprint*

Resistance running, normal sprinting and supramaximal running (running at high speeds using aiding propelling forces) are used regularly as training forms in sprint running. These training forms can be considered as specific sprint training forms that lie on different positions in the force-velocity domain. Thus, a comparison of the effectiveness of these training forms may provide us with practical and theoretical knowledge about the importance of speed specificity in training.

Nineteen generally well trained subjects participated in the study. None of the subjects had previous experience with specific sprint training. They were divided into three training groups: resistance, normal, supramaximal, matched on 20m sprinting performance. Resistance and supramaximal training was done using a towing-or-pulling device, providing extra resistance or propulsion force, depending on the running direction of with regard to the system. The additional forces were selected to give a running speed difference of approximately 6% compared to normal sprinting. All groups trained for 6 weeks with 3 training sessions per week. One training session consisted of 5 sprint-runs over 22 m under the specific conditions. Running times were measured by using photocells. Subjects started their performance 2 m before the first measurement point, so that the very initial acceleration was not taken into consideration. Average stride length and cadence were also recorded for the 20m distance. Pre-test running speeds were 6.67 (0.40), 6.45 (0.41), and 5.88 (0.45) m/s for supramaximal, normal and resistance running, respectively ( $p < 0.05$ ). To test the specific hypothesis that one would improve most on the condition that one trained for, a binomial test (probability 0.33) was used on all 19 subjects, who all improved mostly on the trained form ( $p < 0.001$ ). Stride length, not cadence, seemed to be the steering parameter between the running conditions, with a 5.5% and 5.2% difference between normal running and resistance and supramaximal running, respectively. Cadence increased marginally after training for all groups and tests.

The results are indicative for speed specificity in sprint running with regard to training, even though the training effects were small. The only (weak) transfer to other speeds than the trained speed seems to be toward the slower speeds, which is in favour of supramaximal speed training forms.

### O122C-6

#### The acute effects of whole-body vibration on specific neural and mechanical properties of muscle during maximal isometric knee extension

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*Keywords: vibration, muscle inhibition, potentiation*

The purpose of this investigation was to examine the acute effects of whole-body vibrations on specific neural and mechanical properties of muscle during maximal isometric knee extension (MIKE) with 90 degrees of knee flexion.

Twenty-four healthy, strength trained males were recruited for this randomized cross-over design investigation. The vibration treatment consisted of 3 sets of 60 seconds at a frequency of 30 Hz on a commercially available vibration platform (Nemes-Bosco). The control treatment procedure was identical except that no vibration was administered. Subjects performed these protocols on alternate days in a randomized manner. Electromyography (EMG), muscle inhibition, peak torque during MIKE and the potentiation of resting twitch torque were recorded using an interpolated twitch technique. In each testing session, two baseline measurements were made. This was followed by the intervention (i.e. vibration treatment or control treatment) and two post-intervention measurements. The trial with the highest torque value during MIKE was used for analysis. The change in torque during MIKE, muscle inhibition, and the potentiation of the resting twitch torque following both vibration and MIKE were calculated by the difference between the baseline value and the post-intervention value. Subsequently, the mean difference of the changes between the two testing sessions was analyzed using a t-test with independent samples.

Acute administration of this specific whole-body vibration strategy did not significantly increase torque during MIKE. Vibration treatment resulted in an increase in muscle inhibition for Group 1 but a small decrease in muscle inhibition for Group 2. Furthermore, whole-body vibration did not result in potentiation of the resting twitch torque ( $p=0.570$ ) nor did it affect the amount of potentiation after MIKE ( $p=0.671$ ). However, when compared with the control treatment, the vibration treatment did cause a significantly smaller change in torque ( $p=0.009$ ) and muscle inhibition ( $p=0.025$ ) during MIKE when compared to the control treatment.

It appears that vibration may have provided a protective effect on these parameters throughout the testing session. This may be due to attenuation of fatigue or psychological factors.

### O122C-7

#### Inter-individual differences of anaerobic capacity in the homogenous groups of high performance athletes (rowers and cyclists)

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*Keywords: anaerobic capacity, performance athletes*

We have assumed that conditions of anaerobic reserve realization are determined by both specificity of sports discipline and individualities of interconnected aerobic and anaerobic capacities. Due to the above we have set the



objective to estimate the range and meaning of individual peculiarities of anaerobic capacities within homogeneous groups of elite athletes.

Specially selected groups of rowers ( $n=14$ ,  $\text{Vo}_2 \text{ max}=68,2\text{--}71,1 \text{ ml}\cdot\text{kg}^{-1}\cdot\text{min}^{-1}$ ) and cyclists-pursuit race ( $n=13$ ,  $\text{Vo}_2 \text{ max}=71,2\text{--}73,4 \text{ ml}\cdot\text{kg}^{-1}\cdot\text{min}^{-1}$ ) had similar work capacity. Maximal accumulated O<sub>2</sub>-deficit (MAOD) - 60 s and 115%  $\text{Vo}_2 \text{ max}$  ( $206\pm 11\text{s}$ ) as well as anaerobic specific ergometer tests of moderate (30s) and high duration (120s) (McDougall, 1991) were determined in various days. We have also compared two selected groups - hyper- ( $n=6$ ) and hypokinetics ( $n=7$ ) type of cardiorespiratory responsibility. Special endurance was estimated during 6 min and 4 min tests. Quark b2 (Cosmed) and Oxygen Alfa (Jaeger) gas-analytical devices were used; peaks of blood lactate concentration were also measured.

Within homogeneous groups of rowers and cyclists the highest range of individual differences was observed in anaerobic tests of long duration (120s). The final part of these tests was marked by high range of the degree of  $\text{Vo}_2 \text{ max}$  fractional utilization (71-97%). Differences in anaerobic

reserve according to MAOD at 115% of  $\text{Vo}_2 \text{ max}$  in individual athletes were reliably connected with the degree of aerobic power utilization. Meanwhile, peak levels of athletes' lung ventilation did not depend on the degree of  $\text{Vo}_2 \text{ max}$  utilization and were characterized by high individual range (157-204  $\text{l}\cdot\text{min}^{-1}$ ). The cyclists of hyperkinetic type showed higher anaerobic reserves utilization (MAOD) in tests of shorter duration.

The studies have demonstrated that the same type anaerobic tests of long duration and especially that of MAOD reflect both anaerobic reserve and individual specificity of its realization. It is related with individual type of cardiorespiratory responsibility, and ventilatory compensation of metabolic acidosis. Anaerobic tests of long duration being the most specific for analyzed sports disciplines are to a great extent, integral indices of special working capacity and not just its anaerobic component.

*McDougall et al (1991) Physiological testing of high performing athlete*

## Symposium

### The Paralympic Athletes

S122D

#### S122D-1

##### Hormonal regulation in wheelchair athletes

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*Keywords: hormonal regulation, wheelchair athlete, insulin sensitivity*

The alterations of spinal cord injury (SCI) are besides the reduced functional muscle mass, a result of the interruption of sympathetic pathways in the spinal cord. Dependent on the level of the lesion SCI leads to metabolic or hormonal alterations at rest and during physical exercise.

50 spinal cord injured persons (tetraplegics, lesions level C4-C7; high paraplegics, Th1-Th5; low paraplegics, below Th6) and 8 control persons (C), all male, underwent a graded wheelchair ergometry until subjective exhaustion. Epinephrine, norepinephrine, Cortisol, Insulin, Glucose, and free fatty acids in serum were measured before and after ergometry. Tetraplegics showed significantly lower E and NE levels at rest and only slight increases during physical exercise. Furthermore, the tetraplegic subjects had a significantly higher level of Glucose (99,6 mg/dl) and Insulin (18,2 uE/ml) at rest than the other groups. During exercise an increase of glucose, free fatty acids and insulin was found in high paraplegics (15,8 mg/dl, 0,27 mmol/l, 4,4 uE/ml), low paraplegics (21,5 mg/dl, 0,39 mmol/l, 5,4 uE/ml) and control persons (8,4 mg/dl, 0,1 mmol/l, 8,4 uE/ml), but not in tetraplegics (-14,4 mg/dl, 0,04 mmol/l, -6,9 uE/ml).

SCI persons present a higher glucose and insulin level indicating a higher insulin resistance because of a lack of physical activity, especially in tetraplegics. The response to physical exercise is comparable in paraplegics and control persons. Tetraplegics showed an impaired hepatic glycogenolysis during physical exercise as a result of the interruption in the sympathetic system.

#### S122D-2

##### Biomechanical evaluation of wheelchair athletes

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*Keywords: performance, biomechanics, wheelchair exercise*

Manual wheelchair propulsion in sports is increasingly being studied. Initially, an engineering and physiological perspective was taken. More recently, a concomitant biomechanics interest has emerged. Biomechanics is the application of mechanics and physics laws onto the function and form of biological systems. Within human movement studies generally the laws of Newton are applied. In wheelchair sports the biological system (the user) interacts with a complex assistive device (the wheelchair). In turn both interact with the physical environment. Apart from vehicle related mechanics, which determine speed and maneuverability of the wheelchair, biomechanics can be used to help understand mechanisms of wheeled performance in terms of power output and propulsion technique. More recently, biomechanical studies have also contributed to our understanding of the mechanisms of injury to the musculoskeletal system.

Biomechanical evaluation in manual wheelchair propulsion depends on sophisticated equipment for measurement. Specific force sensing systems have been developed and are used in conjunction with general motion analysis. Thus the kinetic interaction between the athlete and wheelchair is studied. Scientific research is progressing, but is still hampered by methodological limitations, such as the heterogeneity and small numbers of the population at study as well as the inconsistency of employed technologies and methodologies.

There is a need for consensus regarding methodology and research strategy, and a strong need for collaboration to improve the homogeneity and size of subject groups and thus the power of the experimental results. Thus a sufficiently strong knowledge database will emerge, leading to an evidence-base of performance enhancing factors and the understanding of the risks of wheelchair sports.

## S122D-3

**Physical performance testing in handicapped athletes****Ledl-Kurkowski Eveline, Aigner Alfred**

Clinic Salzburg, Austria

*Keywords: oxygen consumption, spinal cord injury, wheelchair ergometry*

Exercise testing in disabled persons does not differ fundamentally from test procedures in able-bodied athletes,

although some specialities have to be considered like the nature of impairment and the dimensions of disability. Often special equipments and test protocols are necessary e. g. crank and wheelchair ergometry. As an example the performance tests of a woman top athlete in alpine skiing (winner of several medals at the Paralympics) are presented as well as the results of examinations of paraplegic team members of the multiple Austrian master in wheelchair basketball.

**Oral Session****Physiology 11: Oxygen Kinetics****O122E**

## O122E-1

**A new model of oxygen uptake kinetics****Stirling James, Zakynthinaki Maria, Saltin Bengt**

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*Keywords: oxygen uptake, nonlinear dynamics, modelling*

We present a new model of the oxygen uptake kinetics in the form of a set of nonlinear coupled ordinary differential equations. Our model is substantially different to the currently used 3-phase model in as much as it is a smooth function of both time, intensity and  $\dot{V}O_2$ . We model the vector for the derivative with respect to time of the  $\dot{V}O_2$  (ie. the  $\ddot{V}O_2$ ) as a nonlinear function of time, intensity and  $\dot{V}O_2$ , and we couple this to another vector, which describes the rate of change of intensity as a function of time. These vectors are then numerically integrated to obtain the time series for oxygen uptake kinetics at different exercise intensities. We gave an example of how the model can be used to model on and off transient kinetics, including such phenomena as the so called slow component. The model can also be used over the whole range of possible exercise intensities to calculate the time series for the oxygen demand and other quantities such as the oxygen deficit or the time spent in a particular range of  $\dot{V}O_2$ . In presenting this work, we show how tools used to study nonlinear time series and nonlinear differential equations are of vast use in the analysis and modelling of the response of physiological variables to exercise.

compulsory medical examination which was obligated for all young Norwegian men obligated to undertake. Subjects who were injured or sick at the time of the test were excluded.

The maximal oxygen uptake in young men in 2001/2002 was 40.2 ml\*kg<sup>-1</sup>\*min<sup>-1</sup> as calculated from the Astrand-Rhyming nomogram. This was 8% lower ( $P < 0.05$ ) than the maximal oxygen uptake in 1980-85 (43.5 ml\*kg<sup>-1</sup>\*min<sup>-1</sup>). In 2001/2002 42% of the men tested, had a maximal oxygen uptake of 37 ml\*kg<sup>-1</sup>\*min<sup>-1</sup> or less, which was 60% more than in 1980-85. In 2001/2002 15% achieved a maximal oxygen uptake of 50 ml\*kg<sup>-1</sup>\*min<sup>-1</sup> or higher compared with 25% in 1980-85. The height in 2001/2002 was 180.2 cm which was 0.4% greater than in 1980-85 ( $P < 0.05$ ). The body weight in 2001/2002 was 74.6 kg which was 7% greater than in 1980-85 ( $P < 0.05$ ). In 2001/2002 those who lived in a city district had a 4% higher maximal oxygen uptake compared with those who lived in the countryside. In 2001/2002, those who smoked daily (28%) had an 8% lower maximal oxygen uptake than those who answered that they had never smoked ( $P < 0.05$ ).

The maximal oxygen uptake (in ml\*kg<sup>-1</sup>\*min<sup>-1</sup>) of 18 year old Norwegian men was 8% lower in 2001/2002 compared with the results from 1980-85. During the same period the bodyweight increased by 7%. The reduced maximal oxygen uptake was due to an increased number of men with low or very low maximal oxygen uptake, and a reduced number of those with high values. Smokers had an average of 8% lower maximal oxygen uptake compared with men who had never smoked.

## O122E-2

**Changes of maximal oxygen uptake from 1980 to 2002 in young Norwegian men****Dyrstad Sindre, Aandstad Anders, Hallén Jostein**

The Norwegian University of Sport and Physical Education, Norway

*Keywords: smoking, BMI, maximal oxygen uptake*

The aim of this study was to compare the maximal oxygen uptake measured at young Norwegian men in 1980-85, with a similar population in 2001/2002. From 1980 to 1985 maximal oxygen uptake were predicted from the Astrand-Rhyming bicycle test in 183 610 eighteen year old Norwegian men. The tested group included 92% of the entire population. In 2001/2002 the Astrand-Rhyming bicycle test was used again to test the maximal oxygen uptakes in a representative sample of 18 year old Norwegian men ( $n = 1028$ ). The test subjects answered questionnaires relative to their health practices. Their body mass indices (BMI) were measured. All the tests were part of the

## O122E-3

**Is the slow component of O<sub>2</sub> uptake linked to selective fatigue of slow twitch muscle fibres in humans?****Borroni Fabio, Maffiuletti Nicola, Millet Guillaume, Deley G  lle, Candau Robin, Millet Gregoire, Martin Alain**

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*Keywords: VO<sub>2</sub> slow component, M-wave, T-reflex*

The mechanisms underlying the VO<sub>2</sub> slow component are not yet completely understood, but the most likely mediator for the VO<sub>2</sub> slow component is the increased recruitment of motor units, particularly fast-twitch units. One technique of investigating neural and contractile properties of muscle fibres consists of stimulating motor nerves and analysing the subsequent muscle compound action potentials (M-waves) and isometric twitch force. The aim of this study was to analyse the effect of intense ergometer cycling exercise on

the contractile and neuronal properties during the VO<sub>2</sub> slow component phase.

Nine subjects performed a constant load cycling exercise at an intensity equalling 25% of the difference between the ventilatory threshold and VO<sub>2</sub>peak. The VO<sub>2</sub> response was fitted with the classical model including two exponential functions. Before exercise (BE), two minutes after the onset (2ME) and at the end of the exhaustive exercise (EE), a battery of tests (T reflex, M wave) was performed to evaluate the changes in neural and contractile properties of knee extensor muscles during the slow component phase.

Across all times, there were: i) no significant change in electrical response of M wave ( $P > 0.05$ ), ii) the changes in mechanical-electrical slope ( $P_t/A_{tot}$ ) of the T reflex were significantly more marked than the changes in the slope of Mmax wave. The first result suggests that the cellular mechanisms that might account for the changes in fibres velocity as reduced Na<sup>+</sup>-K<sup>+</sup> pump activity, temperature, impaired inactivation of Na<sup>+</sup> channels or physical damages, do not interfere or are counterbalanced by other phenomena. Since the T reflex reflects slow twitch fibres contractile characteristics and Mmax wave is the result of the activation of all twitches, the second result would show a more marked fatigued state in slow twitch fibres compared to the rest of the motor units pool of the knee extensor muscles. As a result, a recruitment of new fibres to keep the output power constant, is expected. Because the slow twitches are more exhausted than the fast twitch fibres, the progressive recruitment of new fibres occurs probably in the fast twitches pool.

#### O122E-4

### Influence of intensity on time spent at maximal oxygen uptake during short intermittent exercise in endurance male subjects

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**Keywords:** intensity, intermittent exercise,  $tVO_{2max}$

The aim of this study was to determine the influence of a 10% variation of intensity on the time spent at VO<sub>2</sub>max ( $tVO_{2max}$ ) during a model of short intermittent exercise: the 30s-30s. According to the great influence of exercise intensity on the level of oxygen uptake requirement during short intermittent run, we hypothesised that, for the 30s-30s, an exercise intensity corresponding to 110% of maximal aerobic speed (MAS) (active recovery) would increase the  $tVO_{2max}$ .

11 endurance trained male (mean age 16.5 years  $\pm$  0.3, VO<sub>2</sub>max: 62.5 ml.min<sup>-1</sup>.kg<sup>-1</sup>  $\pm$  1.3, and MAS 17.6 km.h<sup>-1</sup>  $\pm$  0.25) performed 3 field-tests (400 m outdoor tartan track) until exhaustion: 1) an incremental test to determine their VO<sub>2</sub>max, and MAS (initial speed was 12 km.h<sup>-1</sup> and it was increased by 1 km.h<sup>-1</sup> every 2 min). Velocity at the last completed stage was considered as MAS. 2) and 3) in a randomised order, 2 intermittent exercises consisting in repeating as long as possible 30s run at 100% (IT100) or 110% (IT110) of MAS alternating with 30s active recovery (50% of MAS). During all tests, respiratory gas exchanges were measured breath-by-breath using a portable system (Cosmed K4b2) and heart rate (HR) was continuously monitored. Total exercise duration (tlim), time spent at VO<sub>2</sub>max [ $tVO_{2max}$  expressed in second (ie. absolute value) and related to tlim (ie. relative value, %tlim)] and blood lactate concentrations at the end of exercise ([La]) were measured for both intermittent exercises.

Total exercise duration was significantly longer ( $p < 0.001$ ) for IT100 than IT110 (1412.7 s  $\pm$  147.9 vs 643.6 s  $\pm$  59.5). Mean  $tVO_{2max}$  expressed in absolute value was almost two fold higher during IT100 than during IT110 (respectively 300 s  $\pm$  145.2 vs 158 s  $\pm$  65.5) but, because of a great variability between subjects, both values were not significantly different even if they were expressed in relative value (respectively 23.7 %tlim  $\pm$  10.6 vs 25.6 %tlim  $\pm$  9.8). At last, mean blood lactate concentration measured at the end of IT100 (8.7 mmol.L<sup>-1</sup>  $\pm$  1.0) was significantly lower ( $p < 0.05$ ) than after IT110 (10.9 mmol.L<sup>-1</sup>  $\pm$  1.3).

Our results show that an increase of exercise intensity of 10% leads to a large diminution of total exercise duration and to a significant increase of blood lactate concentration. However, the present results seem to demonstrate that the 30s-30s realised at 110% of MAS (active recovery: 50% of MAS) doesn't allowed a significant increase of the time spent at VO<sub>2</sub>max.

#### O122E-5

### Relationships between oxygen uptake kinetics and other measures of aerobic function in middle- and long-distance runners

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**Keywords:** long distance running, oxygen uptake

Endurance training results in several physiological adaptations at a cellular level such as an increased number of mitochondria and increased oxidative enzyme activity (Saltin and Gollnick, 1983). Collectively, these are likely to speed oxygen uptake (VO<sub>2</sub>) kinetics at the onset of moderate-intensity exercise. However, the influence of endurance training on other measures of aerobic function, such as maximal oxygen uptake (VO<sub>2</sub>max), ventilatory threshold (VT) and O<sub>2</sub> cost of running (Cr), might be less pronounced which could potentially dissociate these measures. The characteristics of endurance training (intensity and volume) might influence relationships between measures of aerobic function. Since middle-distance (MD) and long-distance (LD) runners differ in terms of the intensity and volume of their training, the purpose of this study was to explore the relationships between VO<sub>2</sub> kinetics and other measures of aerobic function in these groups of runners.

With ethics approval, 16 male MD and 16 male LD runners completed three laboratory-based tests, on separate occasions, to determine VO<sub>2</sub>max, VT, Cr and on- and off-transient VO<sub>2</sub> kinetics below VT. Relationships between VO<sub>2</sub> kinetics and other measures were explored using Pearson's product moment correlation coefficient. Statistical significance was set at  $P < 0.05$ .

Relationships were observed between on-transient VO<sub>2</sub> kinetics and VO<sub>2</sub>max ( $r = -0.70$ ;  $P < 0.01$ ) and on-transient VO<sub>2</sub> kinetics and VT ( $r = -0.57$ ;  $P < 0.05$ ) in LD runners. The Cr was not related to on-transient VO<sub>2</sub> kinetics in LD runners. There were no relationships between on-transient VO<sub>2</sub> kinetics and any other measure in MD runners. The off-transient VO<sub>2</sub> kinetics was not related to any measure in either MD or LD runners.

The results of this study show that on-transient VO<sub>2</sub> kinetics and other measures of aerobic function (VO<sub>2</sub>max and VT) are inter-related. However, this is not apparent in MD runners, despite similarities in VO<sub>2</sub>max and VT. This could be attributed to the greater emphasis on anaerobic training in MD runners which might dissociate the adaptations in VO<sub>2</sub> kinetics and VO<sub>2</sub>max. Future research should consider the effects of different intensities and volumes of training on VO<sub>2</sub>

kinetics and whether adaptations in VO<sub>2</sub> kinetics are concomitant with adaptations in other aerobic measures.

Saltin B, Gollnick P (1983). *Am Physiol Soc: Handbook of Physiol* 10, 555-631.

#### O122E-6

### Inhibition of nitric oxide synthase by L-NAME speeds oxygen uptake kinetics in the transition to moderate intensity exercise in men

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**Keywords:** respiration, VO<sub>2</sub> kinetics

It is widely believed that the rate at which oxygen uptake (VO<sub>2</sub>) rises at the transition to higher metabolic rates, at least within the moderate exercise intensity domain, is limited by oxidative enzyme inertia within the mitochondria. There is evidence that nitric oxide regulates mitochondrial function through competitive inhibition of cytochrome c oxidase in the electron transport chain (Brown 2000), and it is possible that the limitation to VO<sub>2</sub> kinetics at exercise onset resides at this site (Kindig et al. 2001). We therefore hypothesised that inhibition of nitric oxide synthase (NOS) by nitro-L-arginine methyl ester (L-NAME) would alleviate the inhibition of mitochondrial VO<sub>2</sub> by nitric oxide and result in a speeding of VO<sub>2</sub> kinetics at the onset of moderate intensity exercise.

Seven males (mean (SD) age 25 (3) years, body mass 77.7 (8.3) kg) volunteered to participate in this ethically approved study. The participants performed two square-wave transitions from unloaded cycling to a work rate requiring 90% of gas exchange threshold, separated by 6 min recovery, on four occasions. On two occasions, the exercise bouts were preceded by 60 min intravenous infusion of L-NAME (4 mg/kg in 50 ml saline) and on the other two occasions, they were preceded by 60 min intravenous infusion of 50 ml saline (control). Pulmonary gas exchange was measured breath-by-breath and VO<sub>2</sub> kinetics were determined from the averaged response to the four exercise bouts in each condition.

There were no significant differences between the control and L-NAME conditions for baseline VO<sub>2</sub> (mean (SEM) 785 (32) vs. 764 (24)), time delay (16.3 (1.1) vs. 19.3 (2.2)), or response amplitude (996 (78) vs. 1024 (85) ml/min), respectively. However, the time constant of the response was significantly smaller following L-NAME infusion (22.1 (2.4) vs. 17.9 (2.3);  $P < 0.05$ ).

These data indicate that inhibition of NOS by L-NAME results in a significant (19 %) speeding of VO<sub>2</sub> kinetics in the transition to moderate intensity cycle exercise in man. At least part of the intrinsic inertia to oxidative metabolism at the onset of exercise may result from competitive inhibition of mitochondrial VO<sub>2</sub> by nitric oxide at cytochrome c oxidase.

Brown GC (2000). *Acta Physiol Scand* 168: 667-674

Kindig CA et al (2001). *J Appl Physiol* 91: 891-896

#### O122E-7

### Non-exercise test for aerobic fitness assessment

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**Keywords:** VO<sub>2</sub> kinetics, aerobic fitness

Measurement of maximal aerobic power (VO<sub>2</sub>max) requires typically a maximal effort of the subject tested. For various reasons this is not always possible and non-exercise methods for fitness assessment are needed. This paper describes a development and evaluation of Polar Fitness test, which predicts VO<sub>2</sub>max from demographic variables and resting heart rate. An artificial neural network was used in the development to predict VO<sub>2</sub>max on the basis of gender, age, height, weight, physical activity (low/middle/high/top) and three parameters from a five-minute-period of heart beat intervals; mean, range and maximum. The test was originally developed in 381 healthy adults (258 males and 123 females, age 15-64 years, VO<sub>2</sub>max 25-60 ml/min/kg) and validated in several sub-samples. In all studies subjects were tested in a maximal stress test in laboratory using direct gas analysis as a reference measure of VO<sub>2</sub>max. Correlation coefficient between the laboratory measured VO<sub>2</sub>max and the artificial neural network prediction of first version of Polar Fitness test was 0.97 and the mean error in the VO<sub>2</sub>max prediction was 6.5%. In the further test development study, 450 laboratory fitness measurements of 15-65-year-old healthy men (307) and women (143) were used in analysis. Correlation coefficient between the laboratory measured VO<sub>2</sub>max and Polar Fitness test prediction in this data was 0.96 and the mean error in the prediction was 8.2% (3.7 ml/kg/min). In a validation sample of 43 healthy adults (27 males and 16 females, age 20-65 years) the standard error of estimation was 5.1 ml/kg/min and correlation coefficient 0.93 and in a sample of 59 males (mean age 35 years) 5.1 and 0.80, respectively. In 52 moderate to highly trained subjects (34 males, 18 females, age 18-50 years) the standard error of prediction was 15.1 %, 9.0 ml/kg/min. In males, Polar Fitness Test predicted maximal aerobic power well. In females, Polar Fitness test predicted too high VO<sub>2</sub>max, which was concluded to be due to not normally distributed female group in the training of the artificial neural network. In a sample of 60 overweight men (mean age 45 years, VO<sub>2</sub>max 25.2-50.6 ml/min/kg) Polar Fitness Test did slightly underestimate measured maximal aerobic power and the test was highly repeatable in two consecutive measurements. Polar Fitness Test has also been compared to the self-reported physical activity in 5643 Finnish adults. In men the mean (range) VO<sub>2</sub>max was 37.5 (18.9-72.4) ml/min/kg and in women 34.6 (13.2-80.6), respectively. High levels of self-reported leisure time physical activity were associated with higher maximal aerobic power predictions both in men and women. The Polar Fitness Test was concluded to be a feasible test of aerobic fitness in a large population study.

## Symposium

### Measurement and Therapy in Prevention and Rehabilitation

S122F

#### S122F-1

##### Exercise testing and performance diagnostics

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*Keywords: aerobic performance, turn point concept*

Today there is general agreement that the maximal lactate steady state (MLSS) represents the anaerobic threshold, the most important submaximal marker of aerobic performance. Numerous methods have been presented using different variables to detect "points" and "regions" to define thresholds and phases in incremental exercise tests and to predict the MLSS. Numerous papers compared these very different approaches showing controversies between investigators. Skinner and McLellan (5) showed a schematic presentation of three phases of energy supply which may be seen as the up to date standard in the interpretation of variables obtained in incremental exercise tests. New data support this approach. In this concept blood lactate concentration shows two distinct break points or "lactate turn points" (2). New data support this view of break points (1). Steady state tests around the anaerobic threshold gives support of the view that this turn points are valid markers of the MLSS. (3,7). Carbohydrate availability dependent on nutritional intake and/or glycogen depletion gives additional problems in the interpretation of blood lactate profiles dependent on which concept is applied (4). Additional problems arise from the fact that incremental exercise tests only give an insight into the aerobic power of a subject but do not allow extrapolating to the capacity of the system (6). Repeated tests such as the so called Super-Conconi-Test give both power and capacity. Summarizing we suggest that the turn point concept may be applied in standard incremental exercise tests showing to be independent of nutritional status and performance capacity. Besides testing the aerobic power by incremental exercise tests, additional methods are necessary to assess the aerobic capacity of subjects.

#### S122F-2

##### Exercise prescription in cardiovascular diseases

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*Keywords: rehabilitation, training, exercise prescription*

Exercise training in patients with cardiovascular disease is designed to achieve desired effects (improved functional capacity, reducing risk factors) while avoiding the side effects (injury, cardiovascular emergencies) of exercise training. We will review guidelines for both conventional (%HR, %VO<sub>2</sub>max, ischemic threshold) and innovative (interval training, resistance training) approaches to exercise training. Additionally, we will review new techniques for exercise prescription using subjective methods.

#### S122F-3

##### Mechanical stimulation in neuromuscular diseases

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*Keywords: brain, mechanical stimulation, neuromuscular diseases*

The incidence of neurodegenerative diseases (PD, MS, ALS) is characterized by an increasing development in the European countries. Whereas the neuropathological features are different there are fundamental similarities in motor control abnormalities: ataxia, disturbed sensory function and disturbed reflex pattern. Since pharmacological treatment has been shown to be less effective we aimed at finding alternative treatment or training strategies to improve motor control in these patients. Based on the results of analyses in high performance sports we proved if whole-body-vibration (WBV) could be an effective training device. This paper deals primarily with the results of analyses with PD patients.

Altogether more than 200 subjects with HOEHN and YAHR stage 1-4 participated to several types of analyses. Cross sectional studies were focused on spontaneous changes in motor control achieved by the vibration treatment. Pre- and Post Tests consisted of complex biomechanical test batteries. With respect to usual clinical assessments, motor examination was done by UPDRS. In order to control bias factors one study was organized in a blind design. Treatment is based on five series of WBV taking 60 seconds each. Vibration amplitude was 3 mm; frequency was set at 5 to 6Hz.

Around 80% of analysed patients showed spontaneous improvements in several parameters of motor control. In gait analyses increased gait velocities and reduced ground contact times could be noticed. In strength tests subjects improved their maximum strength about 26 % on average. Data of manual coordination show all over better results and significantly reduced action tremor. In UPDRS motor score test a highly significant improvement of 5.5 points on average was found.

After a general consideration of all findings concerning motor effects of WBV it seems not possible to explain presented results by a single or simple function. In PD the extent of effects as well as the duration of response is characterized by a wide variety. Since some effects continued for several hours acute peripheral changes in sensory behaviour can not explain these results exclusively. It can be speculated that neurotransmitter concentrations e.g. dopamine are affected by the stimulation since the results of animal experiments indicate this kind of function of WBV. A further model relates to a modification of pathologically changed activation of brain areas e.g. thalamus.

S122F-4

**Efficiency of conservative treatment strategies in tendinopathies****Mayer Frank, Baur Heiner, Gollhofer Albert, Dickhuth Hans Hermann**

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*Keywords: rehabilitation, tendinopathy, therapy*

Chronic complaints of the musculotendinous system in sports are frequent. However, limited evidence based data for valid injury treatment strategies are available.

Recent publications and clinical experience show an increasing impact of tendinopathies, where differentiation should be made between injury site and histological status. Non-insertional injuries are subdivided into acute, load-dependent tendinitis or peritendinitis and chronic degeneration (tendinosis) including weakening and partial rupture. Acute inflammation is accompanied by cumulative pain and swelling with increased loading. Degeneration often reveals initial pain while starting physical activity. Pain symptoms might be reduced with ongoing loading and recur after long term exercise. In insertional tendinosis, load-dependent pain is accompanied by pungent palpation pain at tendon insertion. MRI and sonography are recently the most common methods in diagnostics. Causes for tendinopathies are discussed controversially. Previous work indicate frequently

increased loading due to musculoskeletal malalignment, training errors, insufficient shoe supply and other external factors, whereas recent publications emphasize on changes in neuromuscular regulation mechanisms. Beside that, deficiency of force capacity and force relations in functional chains plays an important role while sensorimotor control remains of great importance.

A lot of pathologies or complaints can not be addressed to one specific treatment or a specific individual response. Therefore most cases are treated with a combination of therapeutic measures. In inflammation, local antiphlogistic measures can be supported by physical therapy and physiotherapeutic procedures. Local steroid infiltrations should be limited to osseous insertion sites. Systemic antiphlogistic treatment is question-able in chronic tendinosis. Physiotherapy (deep friction massage, myofascial techniques, eccentric strength training, stretching) biomechanical orientated treatment and especially sensorimotor training are recent methods of use in chronic tendinopathies. After a 3 month resistance towards conservative treatment strategies surgical intervention might be appropriate. The multiplicity of therapy strategies and their indiscriminate use are time and cost consuming. Therefore verification of efficiency of different strategies and effective assignment to individual- or group-specific therapy responses is desirable.

**Symposium****The epistemological ecologies of sport and exercise sciences (ICSSPE Exchange Symposium)****S122G**

S122G-1

**The epistemological ecologies of sport and exercise sciences****McNamee Mike, Camy Jean, Duda Joan, Hogenova Anna, Loland Sigmund, Madella Alberto**

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*Keywords: philosophy, epistemology, science*

For some time now philosophers and social scientists have challenged the hegemony of the natural sciences in relation to its shaping of the scientific cultures of sport and exercise. First, there is a mode of communication and scientific reporting that is essentially assertive unlike the dialogical environments of the social sciences and humanities. What is known as the "Poster" format not only provides unidirectional knowledge transfer but functions to privilege the experimental disciplines that report their "findings" in highly compressed modes. This is enabled, largely, by a relatively shared background of theoretical commitments. A further crucial point of contrast is the tendency - required by the very specialisation and technicisation of experimental sport and exercise science - to produce teams of scientists who generate comparatively larger volumes of research outputs than their social scientific and humanities-based colleagues, from single projects at a greater frequency because of their team-approach to investigation and publication. By contrast,

those disciplines that are either theory-saturated from the beginning (typically in the social sciences and the humanities in sport and physical education, or those in which single authorship is the norm or gold-standard, are either marginalized, relegated, or excluded either implicitly or explicitly by the format of international scientific conferences. This given that poster presentations are neither well suited to theory-saturated research nor recognised as an appropriate currency of scholarship, the mode of conference presentation and culture mitigates against their presence and the celebration of their contributions to more comprehensive research programmes. These matters are re-inforced by a greater range of research journals for those working in the experimental sciences. A virtuous cycle has emerged where there were key international journals pre-disposed to a quasi-positivistic research orientation, supported by conference modes of presentation and organisation, and amplified by research outlets that were disposed to the currency of multi-author, abstract-driven publications. These reflections are amplified by other biases including, for example, gender and language. The hegemonic position of the natural sciences incorporates disproportionate representation of males over females and of the English language over other natural languages. These and related issues will be addressed as important intellectual and professional issues with sports and exercise sciences and humanities.

## Symposium

### Exercise and Metabolic Syndrome

**S122H****S122H-1****Physical training, dyslipoproteinemia and muscle lipids****Helge Jørn**

University of Copenhagen, Denmark

*Keywords: training, lipids, metabolic syndrome*

Regular physical training has profound effects on lipid content and composition in the circulation and within skeletal muscle, and these effects mediate an attenuation of dyslipoproteinemia and insulin resistance two of the key components of the metabolic syndrome. A recent randomised prospective study by Kraus and colleagues (NEJM, 2003) demonstrated that compared to a control group 8 months of either low amount & moderate intensity, low amount & high intensity or high amount & high intensity exercise lead to positive changes in overall lipoprotein profile in overweight subjects with mild to moderate dyslipidemia. Furthermore, the improvement was related to the amount of exercise rather than the intensity. Many other studies have demonstrated beneficial effects of regular physical training on the lipoprotein profile. The training induced increase in lipoprotein lipase activity in muscle and a decrease in hepatic lipase activity probably both contribute to the effect of physical training on the lipoprotein profile, but the exact mechanism remains elusive.

In muscle the application of the <sup>1</sup>H NMR spectroscopy technique have linked excessive triacylglycerol storage to increased insulin resistance. However, as physical training has been reported to increase skeletal muscle triacylglycerol storage and decrease insulin resistance, there appears to be a paradox. Physical training markedly increases the capacity to transport and oxidize lipids in skeletal muscle and this may mediate altered triacylglycerol storage localization in muscle, which may attenuate the deleterious effects of increased triacylglycerol storage. In addition to lipid storage, regular physical training also exerts an effect on the structural lipids in muscle. Studies have demonstrated that regular physical activity mediates a change in skeletal muscle membrane phospholipid fatty acid composition (Helge et al., J. Appl. Physiol. 2001), which is compatible with a decreased insulin resistance.

In conclusion, the beneficial effect of regular physical training on lipids in the circulation and in skeletal muscle emphasizes the need to promote physical training and combat physical inactivity.

**S122H-2****Physical training and adipose tissue metabolism****Stallknecht Bente**

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*Keywords: training, lipolysis, adipose tissue metabolism*

Trained subjects oxidize more lipid compared with sedentary subjects during exercise. One could thus expect adipose tissue lipolysis to be increased in trained compared with sedentary subjects. Indeed, numerous in vitro studies have found a training-induced increase in epinephrine-stimulated

adipose tissue lipolysis. However, when exercising at the same absolute intensity in vivo whole body lipolysis is either the same or lower in trained compared with sedentary subjects, and subcutaneous abdominal and femoral lipolysis as estimated by microdialysis technique does not differ between trained and sedentary subjects. At rest most evidence (in vitro and in vivo) suggests no effect of training on basal adipose tissue lipolysis. Whole-body as well as subcutaneous abdominal adipose tissue lipolysis stimulated by physiological epinephrine concentrations in vivo do not differ between trained and sedentary lean subjects, but epinephrine-stimulated lipolysis in intra-abdominal adipose tissue is increased in trained rats. Moreover, indications of a training-induced increase in catecholamine-stimulated adipose tissue lipolysis have been found in obese subjects. The influence of training on the activity of the enzyme hormone sensitive lipase, which is rate-limiting for lipolysis, is not clear, as both an increase and a decrease have been found.

Between exercise sessions adipose tissue energy stores must be refilled and one energy source is glucose. In vitro as well as in vivo studies suggest a training-induced increase in insulin-stimulated glucose uptake in adipose tissue. Moreover, number of glucose transporters (GLUT-4) and GLUT-4 mRNA in adipose tissue is increased by training. In adipose tissue glucose can be stored as glycogen or triacylglycerol (TG), oxidized or released as lactate. In rat adipocytes insulin-stimulated glucose oxidation and incorporation into the fatty acid part of TG has been found to be increased. Another energy source is plasma TG, and the enzyme lipoprotein lipase (LPL) catalyzes the uptake of free fatty acids from plasma TG. However, the effect of endurance training on adipose tissue LPL activity remains controversial. Degradation of adipose tissue TG between exercise sessions might be influenced by training as in vivo adipose tissue lipolysis was more sensitive to suppression by insulin in trained compared with sedentary subjects.

In conclusion, several aspects of adipose tissue metabolism are influenced by training.

**S122H-3****Exercise with or without weight loss is an effective strategy for the prevention and treatment of abdominal obesity and related comorbidities****Ross Robert**

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*Keywords: exercise, obesity, insulin resistance*

In 1998 a group of experts gathered by the National Heart, Lung and Blood Institute and other National Institute of Health branches published a detailed review the objective of which was to propose guidelines for the prevention and treatment of obesity and its co-morbidities. Building on this foundation, the American College of Sports Medicine sponsored a scientific round table to specifically address the role of exercise in the prevention and treatment of obesity. The consensus statements that result from these initiatives are important, and those interested in the treatment of obesity and its co-morbid conditions are encouraged to review them. With

respect to the role of exercise in obesity reduction, both statements recognize that the addition of exercise to a regimen of diet restriction affects body composition favorably by promoting additional fat loss, albeit minimal, and preserving lean tissue. However, they also conclude that physical activity alone (e.g. without caloric restriction) in overweight and obese men and women reduces total (~2%) and abdominal fat (~2 cm) only modestly or not at all. Many would consider a weight loss of this magnitude inconsequential and conclude that exercise alone is largely ineffective as a method of obesity reduction. However, careful review reveals that many of the studies from which these conclusions are drawn suffer from limitations which confound interpretation. For example, in the vast majority of

studies individual energy intake and expenditure was neither rigorously controlled nor accurately measured. Moreover, with few exceptions the negative energy balance induced by exercise was modest to the degree that one would not expect substantial weight loss. Indeed, no compelling evidence exists to support the observation that exercise alone is not a useful method for reducing total or abdominal obesity. Indeed, recent evidence counters the dogma that daily exercise produces only modest weight loss and suggests that exercise without diet restriction is an effective strategy for reducing obesity and related co-morbidities. The data in support of this opinion will be presented.

## Oral Session

### Biomechanics 11

O1221

O1221-1

#### Individual effects of additional weights used in ancient Greek Olympic pentathlon

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**Keywords:** halteres, Ancient Olympics, modelling

In ancient Olympics, jumping was part of the pentathlon. The jumpers held additional weights, so-called halteres, in their hands to increase the jumping distance. Minetti et al. (Minetti 2002) showed that the weights used in the competitions had approximately the mass for optimizing the jumping distance for average jumpers. However, measurements revealed that not every athlete could improve his performance (Minetti 2002). Our simulations take into account the individual properties of subjects and can therefore explain the differences in performance.

7 subjects (age 23.5 ± 2.5 years, mass 71.7 ± 9 kg, height 1.75 ± 0.12 m) performed concentric and dynamic movements with maximal voluntary effort on an inclined force bank. The movements are described by a mathematical model (Sust 1996). In the equation of motion the parameters representing the individual muscle properties of the knee extensor are found by nonlinear parameter estimation. In addition, the force produced by arm movements with different additional weights was measured. Vertical jumps with different arm movements were simulated (Schmalz 1994).

There are individual differences in the influence of arm movements with additional weights on a jump. The force produced in the muscle is not constant during a movement but depends on the contraction velocity of the muscle (Hill 1938). Therefore, the muscle force and the energy of the jump increase when a force against the direction of the movement caused by the arms decreases the velocity at the beginning of a jump. However, the extent of the benefit of an arm movement depends on the individual properties of the subject. An additional weight held in the arms leads to a greater jump height for one person, whereas for another person the jump height decreases. The optimal additional weight depends on the single subject. There can even be a change in the order of jump heights: A person who jumps higher than another without the use of weights need not be the better one in a jump with additional weights. So the use of weights in the Olympic jumping competition in ancient Greece did not have the same advantage for all athletes.

Hill A V (1938). *Proc. R. Soc. London B*127: 136-195

Minetti A, Ardigo L (2002). *Nature* 420: 141-142

Schmalz Th (1994). *Wiss. Schriftenreihe d. Deutschen Sportbundes* 26

Sust M (1996). *Grundlagen der Biomechanik des Sports*

O1221-2

#### Estimations of total swimming efficiency in children and adults

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**Keywords:** swimming, efficiency, children

Total efficiency (et) in swimming is the portion of the total energy liberation used for propulsion. This can provide useful quantification for evaluation of a swimmer's effectiveness. The purpose of this study was to compare total efficiency in children and adults to enhance understanding of developmental changes of swimming during maturation.

Ten children (age 11.7 years) and 13 adults (age 21.7) were tested for active drag (AD) and oxygen consumption during swimming. AD was calculated on the basis of the velocity difference between swimming at maximal velocity, and the velocity attained while towing a known resistance according to the following formula:  $AD = (F_b \cdot u \cdot v^2) / (v^3 - u^3)$ , where  $F_b$  is the known resistance,  $v$  and  $u$  the free and towing velocities respectively.  $VO_2$  was measured with a Douglas bag system, modified to work along the pool deck. Subjects swam at 4 submaximal workloads of 4 and 6 min duration and velocities of 0.7-1.0 and 0.8-1.2 m/s for the children and adults respectively. Total efficiency was estimated as  $et = E/P_d$ , using extrapolated drag and  $VO_2$  at 1.0 m/s to find the power to overcome drag and the energy consumption (E) respectively. Coefficient of drag (CD) was calculated by dividing AD through velocity squared and projected frontal area.

The total efficiency for children and adults was  $0.045 \pm 0.014$  and  $0.031 \pm 0.013$  respectively ( $p < 0.05$ ). Adults had significantly greater AD at any given velocity than children ( $33.0 \pm 20.2$  vs  $14.0 \pm 3.1$  N at  $1.0 \text{ m} \cdot \text{s}^{-1}$  respectively), but there was no differences in CD (velocity and size adjusted drag).

The results of this study show that adults had higher active drag and maximal velocity than children, as would be expected. After adjusting drag for body size, adults and children were not significantly different in drag. However, the estimated total efficiency was greater in children than in adults—contrary to what might be expected. Adults' values for et of this study were found to be 5-8% lower than reported



elsewhere. Children are observed to float more horizontally than adults, which cause less body drag. This may explain their better total efficiency. It is concluded that children have a better total efficiency than adults but further research is needed in order to confirm this unexpected finding.

## O122I-3

### Influence of shoe midsole bending stiffness on running economy, joint energetics and muscular activation

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**Keywords:** *running, footwear, economy*

It has been observed that mechanical energy is dissipated at the MTP joint during running, sprinting and jumping (Stefanyshyn and Nigg, 1997, 2000). The authors showed that increasing the amount of bending stiffness of the shoe significantly reduced the amount of energy lost at this joint. No experimental evidence exists to show a definite physiological advantage. The hypothesis of the present study is that by decreasing the energy dissipated at the MTP joint, subjects will show improved running economy. This study will also examine the underlying mechanisms possibly attributed to the changes in economy.

A total of six running economy tests were collected over two consecutive days. One test was performed for each of two shoe conditions (control and stiff) with the first condition being repeated for reliability purposes. Economy tests were conducted on a treadmill while running at one workload above each subject's aerobic threshold. Additional data will be collected on the subjects listed below, as well as on the 10 subjects scheduled to be tested in the months to follow. Once physiological data has been collected, subjects will perform twenty trials in each shoe condition while running over a force platform. Kinetic and kinematic data will be collected during these running trials. Joint power and joint work will be calculated from this data. EMG data for five lower extremity muscles will be recorded during over-ground trials and running economy tests. RMS values will be calculated for each muscle over three time windows of the stance phase.

Preliminary data showed that for S1 economy did significantly improve when wearing the stiff shoes (control=2.5028(0.01396)L/min; stiff=2.4115(0.03035)\*L/min). The opposite was observed for S2, he showed significantly better economy in the control shoe (control=3.3202(0.02509)\*L/min; stiff=3.4116(0.04093) L/min).

There seems to be evidence that shoe midsole bending does significantly affect running economy. Whether this mechanical characteristic of running shoes has a beneficial or detrimental affect on performance has yet to be determined. However, understanding the reasons why there are such effects is of importance. What remains to be investigated are the mechanisms possibly affecting the outcome of the economy tests.

Stefanyshyn, D.J., Nigg, B.M. (1997). *J. Biomechanics*, 30, 1081-1085.

Stefanyshyn, D.J., Nigg, B.M. (2000). *Med. Sci. Sports Exerc.*, 23, 471-476.

## O122I-4

### Effects of exhaustive jumping exercise on running economy

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**Keywords:** *EMG, running, oxygen consumption*

Marathon running has been demonstrated to decrease running economy 2 days (2D) after the marathon, which has partly been explained by muscle damage (Kyröläinen et al. 2000). The present study was designed to investigate changes in running economy, running mechanics, neuromuscular function and muscle inflammation and their interactions induced by exhaustive jumping exercise.

12 healthy males performed very exhaustive jumping exercises on a sledge apparatus. Before, 2D and 8D after this fatiguing exercise, the subjects ran on the treadmill in the three different conditions (level, downhill and uphill running) having the individually predetermined constant speed.

Exhaustive jumping exercise did not affect ( $p < 0.05$ ) running economy measured at 2D. Mean oxygen consumption was about 31 ml/kg/min during the level running, 24 ml/kg/min during the downhill running, and 43 ml/kg/min during the uphill running. Averaged EMG values and muscle activity patterns were the same at before and 2D measurement points. However, stride frequency increased ( $p < 0.01$ ) due to shortened flight time ( $p < 0.05$ ), duration of the braking phase shortened ( $p < 0.05$ ), and the lowest knee angle during the contact phase increased ( $p < 0.05$ ). Leucocytes increased peaking already 2 hours post exercise, while CK peaked simultaneously with muscle thickness 2D post exercise.

The present findings do not confirm that oxygen consumption increases in the damaging skeletal muscle, which is contrary to the earlier study (Kyröläinen et al 2000). In the present many compensatory mechanisms, which assist to maintain the constant physiological loading exist during submaximal running. For maximal running, however, a reduction in the neural input to the muscle and its impaired contractile function has been suggested to cause a decrease in physical performance after an exhaustive marathon run (Nicol et al 1991). In the present study, the subjects changed their running mechanics. The shortened braking phase and more extended knee joint during contact do not only reduce pain sensation but may also increase utilization of passive elastic structures of tendomuscular complexes. As a consequence, the amount of active muscle mass required to maintain the constant submaximal running speed is smaller and, therefore, no significant increase in oxygen consumption may be necessary.

Kyröläinen H et al (2000) *Eur J Appl Physiol* 82: 297-304.

Nicol et al (1991) *Scand J Med Sci Sports* 1:18-24.

## O122I-5

### Dynamic and electromyographical analysis in variants of push-up exercise

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**Keywords:** *EMG, dynamics, push-up*

Push-up exercises and variants of those (EV) are widely used in programmes for upper body strengthening. However, there are a few research data which describe the relative dynamic and muscular changes throughout EV. The purpose of this study was the recording of muscular activity and dynamic

behaviour and the investigation of their differentiation during push up EV.

The sample consisted of 8 male students [age 20.5(0.4) yrs, height 176.8(2.3) cm, weight 74.4(5.1) kg]. Surface electrodes were placed on triceps and Pectoralis Major in both sides (1000 Hz). RMS was calculated for each muscle and EV and expressed relative to RMS of normal EV. GRF were recorded with a force plate (Kistler 9281B11, 750 Hz). Subjects executed 6EV of push-ups (5 repetitions): normal, shoulders' abduction (150%), adduction (50%), anterior to initial hand position (-30% of arm & forearm length), posterior (+30%) and on knees. MANOVA for repeated measures was contacted.

Multivariate test was significant ( $F=2.402$ ,  $p<0.05$ ). Significant effects existed for most Fz variables but not for anteroposterior forces and time variables. The initial Fz and initial Fz /BW was significantly different between all EV ( $F=60.306$  and  $F=59.753$ ,  $p<0.05$ ) except between Normal, Abducted and Adducted. The dynamic profile differed between Anterior and Posterior variant, as there were significant differences between them in Fzmax ( $F=6.271$ ,  $p<0.05$ ), Fzmax/BW ( $F=6.046$ ,  $p<0.05$ ), Fz negative integral ( $F=10.269$ ,  $p<0.05$ ) and Fzrange ( $F=6.824$ ,  $p<0.05$ ). Fz min and Fz min/BW decreased significantly ( $F=7.173$  &  $F=7.157$ ,  $p<0.05$ ) from Normal and Anterior to on knees EV. Almost all muscles showed less activity during the on knees and the abducted EV but higher during adducted and posterior. At the anterior EV, Pectoralis Major was activated higher than normal, however triceps lowered their activity.

Dynamic behaviour was significantly altered between variants of push-ups. Greater vertical forces were observed during the anterior EV where Pectoralis Major seemed to be activated higher than triceps. Smaller forces were observed during the on knees EV where muscle activity was also lowered. Instructions for push-up exercises should be made carefully because muscular and dynamic challenge is altered when hands are differently positioned.

Donkers MJ et al (1993). *J Biomech* 26: 625-632; Lear LJ, Gross MT (1998). *JOSPT* 28: 146-157

#### O122I-6

### **A study on the anticipation and detection of muscular failure: analysis of the FFT of the ground reaction force time series during repetitions of one-arm push-ups**

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*Keywords: muscular failure, tremor, Fourier analysis*

Fatigue, resulting from a large number of repetitions, is considered to increase both the amplitude and the frequency of muscular tremor during exercise. From a mathematical point of view it can be assumed that there exists an attractor corresponding to the exercise's ideal motion. Muscular failure can be considered to be the result of a bifurcation in the attractor, resulting in loss of attraction and finally an inability to complete the task.

For the purposes of the present study two healthy female athletes were asked to perform two sets of a non-stop series of one-arm push-ups, until muscular failure. One of the sets of exercises lead to muscular failure, while the second one stopped prematurely. The kinetic data acquired by the platform were digitised at a sampling rate of 103 Hz and later transformed into spherical coordinates. The data were not subjected to any low or high pass frequency filters. The frequency spectrum was calculated by applying a Fourier transform (FFT) to the data.

In accordance with the existing literature, the results revealed a close relationship between changes in tremor and how close the athlete is to muscular failure. Detailed examination of the high frequency spectrum of the kinetic data at failure revealed the appearance of an additional high frequency signal. A similar signal also appeared in the time series of the repetition just before failure. However, concerning the set of exercises which stopped prematurely, observation and Fourier analysis of the failure region of the time of the last repetition revealed no signs of high frequency signals. In addition no significant changes in tremor frequencies and amplitude were observed during the repetitions. The presence of such a high frequency signal on the time series of the kinetic data for the repetition before failure, combined with changes in the tremor frequency and amplitude, can be used as a mean to prescribe the load at which an athlete could train at, when maximum load is desired in the training session.

On the other hand, the lack of such a high frequency signal can be used to show that the athlete is not at maximum load and hence failure at such sub-maximal load could be identified and classified as premature.

Zakynthinaki M S, Stirling J R (2003). *Appearance of high frequency signals combined with fatigue-induced increases in tremor as a means for the anticipation and detection of muscular failure, UPC Preprint.*

Kantz H, Schreiber T (1999). *Nonlinear time series analysis*  
Viitasalo J T, Gajewski J (1994). *Human movement science.*, Vol 13: 129-141

#### O122I-7

### **A longitudinal study of talented youth rugby players with special reference to skill, growth and development.**

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*Keywords: rugby, skills, growth*

Talent identification is a long-term process in which potential sportsmen and sportswomen are identified and developed in a specific type of sport. A longitudinal study or monitoring of talent provides the best results because the development of sportsmen and sportswomen's skills, as well as certain key factors, will ensure success. Growth and development play an important role in the effective talent identification as a long-term process.

The aim of this study was to establish the effect that growth and development had over a period of five years on ten year-old rugby players who had been identified as talented (N=43). The battery of tests, based on the demands of the game of rugby for the evaluation of rugby specific skills, physical and motor skills, and anthropometric measurements was carried out in March 1995, June 1996, June 1997 and June 1999. Basic statistical analyses (x, s) and inferential analyses (p- and d - values) were conducted on the data. The Statistical Analysis System computer package of the Potchefstroom University for Christian Higher Education as well as Statistics was used.

In conclusion it can be reported that growth and development had a significant influence on the performance of talented youth rugby players over the period of five years. This can be verified by the results of the rugby specific skills, physical and motor skills as well as the anthropometric measurements, which all showed a significant improvement.

## Oral Session

### Biomechanics 12: Eccentric Muscle Activity

O122J

O122J-1

#### Connective tissue may play an important role in muscle pain and adaptation after high intensity eccentric exercise

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**Keywords:** *eccentric exercise, extracellular matrix, muscle tenderness*

A single bout of high intensity unaccustomed eccentric mechanical loading is known to be associated with muscle tenderness in the days following the exercise. This tenderness is hypothesized to be brought about by disruption to the muscle fibre, however only a few studies have been able to show this connection in human studies. The aim of this study was to identify alterations in the extracellular matrix (ECM) and to assess mechanisms for muscle tenderness.

Eight untrained males (22 - 30 yrs) performed 210 maximum eccentric contractions utilizing an isokinetic dynamometer on one leg only, the contralateral leg acted as the control. Muscle biopsy samples were obtained from the vastus lateralis muscle of the exercising and controled leg immediately following the exercise bout and 2, 4 and 8 days post-exercise.

Standard assessments of muscle damage, creatine kinase concentration ( $9628 \pm 16\ 151$  U/l) and muscle tenderness ( $8 \pm 2$  - arbitrary scale of 1-10), indicated muscle damage had occurred within the exercising muscle. Despite this, no fibre necrosis was evident at any time point, however CD68+ reactive macrophages were observed within the perimysial spaces of the exercising leg only commencing at day 2 post exercise. Further, a remodeling within the ECM was noted with an increase in staining of pro collagen peptide type 1 and tenascin-C, which commenced at day 2 post exercise and was maintained until day 8 post exercise.

This study suggests that damage to cytoskeletal proteins and fibre necrosis is not a dominating signalling mechanism for muscle pain. Rather it is suggested that the surrounding connective tissue may play a more dynamic role in post exercise muscle adaptation than previously reported.

O122J-2

#### Muscle damage and muscle performance following two eccentric training protocols with different muscle length in healthy males

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University of Thessaly, Greece

**Keywords:** *creatine kinase, isokinetic dynamometry, delayed onset muscle soreness*

The purpose of the present study was to investigate quadriceps muscle damage and performance indicators at short (S) and long (L) muscle length during eccentric exercise.

Twelve healthy male volunteers ( $21.0 \pm 1.0$  years) underwent two exercise sessions in an isokinetic dynamometer at  $60^\circ/\text{s}$ ,

one on each randomly selected leg, 14 days apart. During both exercise sessions, each subject had to accomplish 12 sets of 10 maximal efforts. Subjects exercised in seated and prone position to achieve S and L muscle length of rectus femoris, respectively. Muscle damage indicators (serum creatine kinase concentration, delayed onset muscle soreness) and a muscle performance indicator (eccentric peak torque) were assessed pre- and 24, 48, 72 as well as 96 h after each session.

Compared to baseline, creatine kinase did not change significantly after either session and did not reveal significant differences between the two exercise bouts at any time point. Delayed onset muscle soreness increased significantly ( $p < 0.02$ ) after both sessions. The same muscle damage indicator revealed significant ( $p < 0.02$ ) differences between the two exercise bouts at almost all time points post-exercise, being higher in S compared to L muscle length. Eccentric peak torque decreased significantly until 72 h ( $p < 0.05$ ) and 48 h ( $p < 0.01$ ) following S and L exercise, respectively. However, there were no significant peak torque differences between the two exercise sessions.

In conclusion, both S and L quadriceps eccentric muscle training caused muscle damage but S eccentric exercise seemed to affect muscle to a greater degree. Muscle damage is only partly reflected by changes in muscle performance, especially after L eccentric exercise. These results could be attributed to the elastic components of muscle, which add to the tension present in the muscle when the muscle is stretched.

O122J-3

#### Force deficit after eccentric strength exercise is related to ultrastructural changes in muscle fibers

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**Keywords:** *muscle damage, sarcomere disruption*

Ultrastructural changes in myofibrillar organization are well established after strenuous eccentric muscle contractions (e.g. Gibala et al. 1995). However, a clear correlation between individual manifestations of structural damage and reductions in maximal force-generating capacity has not been established. It is also unclear which proteins are the most vulnerable during eccentric exercise. Therefore, one purpose of this study was to reinvestigate the relationship between ultrastructural damage and force reduction after eccentric exercise, and to look for special changes in desmin quantity and location.

Eleven healthy male students (22-34 yr) performed eccentric knee extensions with one leg. The workout consisted of 300 maximal contractions ( $30^\circ/\text{s}$ ); lasting 35 min. Force-generating capacity was measured in maximal isokinetic concentric knee extensions before exercise, and regularly during the next 8 days. Biopsies were obtained from m. vastus lateralis. Further they were placed in a fixative, cryoprotected in graded concentration of glycerol and embedded in Lowicryl HM20 using freeze substitution. Ultra-

thin sections were mounted on nickel grids and stained with uranyl acetate and lead citrate. Myofibrillar disruptions were quantified using electron microscopy as in Gibala et al. (1995). Disruptions were characterized as sarcomeres with non-linear z-disks and non-parallel filaments. So far 3 subjects are analyzed.

Peak torque was reduced by  $47 \pm 5\%$  5 min after the workout and did not recover completely within 1 week. In all samples analyzed so far, more disruptions are seen in the exercised leg (~50% vs. ~10% of fibers in control leg). Further, only samples from exercised legs have shown disruptions larger than 2x2 sarcomeres. The subject with the largest force deficit (-64%) had the most pronounced disruptions (79% of all fibers) after exercise.

Because of the small number of samples analyzed so far, conclusions can not be drawn. However, a decrease in maximal strength seems to be related to the magnitude of disruptions, adding further indices to the theory that sarcomeric disruptions is one of the most important mechanisms of fatigue after a bout of eccentric exercise. Biochemical and histochemical analysis of structural proteins will be done from the same samples in order to address the role of desmin in exercise induced muscle damage.

Gibala MJ et al (1995). *J Appl Physiol* 78: 702-708

#### O122J-4

### Force deficit after eccentric exercise is related to muscle leukocyte infiltration

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**Keywords:** muscle damage, recovery, inflammation

A secondary loss of force the day after maximal eccentric exercise (MacIntyre et al., 1996) and also after traditional resistance exercise (Raastad & Hallen, 2000) might be related to infiltration of leukocytes. We hypothesised that a relationship exists between the degree of reduced ability to generate force the day after exercise and the number of infiltrated leukocytes in exercised muscles.

Eleven healthy male students ( $27.5 \pm 3.5$  y,  $180 \pm 8$  cm,  $82.6 \pm 6.4$  kg) performed an eccentric knee extension workout with one leg. The workout lasted 35 min and consisted of 300 (30 series of 10 reps) maximal isokinetic eccentric knee extensions ( $30^\circ/\text{s}$ ). Force generating capacity was measured in maximal isokinetic concentric knee extensions ( $60^\circ/\text{s}$ ) before exercise, and regularly during the next 8 days. Infiltration of leukocytes was measured with a scintigraphic method in six of the subjects. The  $99\text{mTechnetium}$ -labelled leukocytes were scintigraphically quantified with a computerised gamma camera. Values presented are means  $\pm$  SEM.

Peak torque was significant lower in the exercised than in the control leg 0-167 h after the exercise. Five min after the workout (0 h) peak torque was reduced by  $47 \pm 5\%$ . The force recovery followed a biphasic pattern, with a significantly increased force from 0 h to 6, followed by a stagnation lasting to 71 h after exercise. The eccentric work resulted in a significantly increased infiltration of  $99\text{mTechnetium}$ -labelled leukocytes in the exercised leg, compared with the control leg. The most pronounced difference was observed in m. rectus femoris. There was a correlation ( $r=0.82$ ,  $p<0.05$ ) between infiltration of neutrophil granulocytes 8 h after exercise and reduced ability to generate force 23 h after exercise.

We found a positive correlation between infiltration of leukocytes and loss of ability to generate force in the same muscles. This suggests that infiltrating leukocytes influence the recovery process after eccentric exercise, and supports the hypothesis that these leukocytes increase the degree of muscle damage after intensive strength training and maximal eccentric work.

MacIntyre DL et al (1996). *J Appl Physiol*, 80, 1006-1013

Raastad T, Hallen J (2000). *Eur J Appl Physiol*, 82, 206-214

#### O122J-5

### Delayed leukocytosis and HSP 70 in plasma after eccentric muscle damaging exercise

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**Keywords:** stress proteins, leukocytosis, monocytosis

Strenuous exercise results in a delayed increase in number of circulating neutrophil granulocytes and monocytes. Recently, HSP 70 was shown to bind to monocytes and a pro-inflammatory role of HSP 70 was suggested (Asea et al., 2000). Since HSP 70 plasma levels have been observed to increase rapidly after exercise (Walsh et al., 2001), we hypothesised that a relationship exists between exercised-induced changes in plasma HSP 70 levels and delayed monocytosis after exercise.

Eleven healthy male students (22-34 yr) performed eccentric knee extensions with one leg. The workout consisted of 300 (30 series of 10 reps) maximal contractions ( $30^\circ/\text{s}$ ); lasting 35 min. Force-generating capacity was measured in maximal isokinetic concentric knee extensions ( $60^\circ/\text{s}$ ) before exercise, and regularly during the next 8 days. Blood samples were obtained before exercise and thereafter 3 min, 0.5, 1.0, 6, 23 and 28 h after exercise. Blood samples were analysed for total and differential leukocyte counts, high-sensitive CRP ( $\mu\text{CRP}$ ) and HSP 70.

After 300 maximal eccentric knee extensions maximal force generating capacity was reduced by  $47 \pm 5\%$ . The expected delayed leukocytosis was observed with a  $104 \pm 14$  and  $69 \pm 10\%$  increase in circulating neutrophils and monocytes, 6 h after exercise, respectively. HSP 70 blood levels increased moderately from  $147 \pm 62$  pg/ml before exercise to  $486 \pm 153$  pg/ml 1 h after exercise. Individual HSP 70 levels peaked 0 - 1 h after exercise, but there was a poor correlation between changes in HSP 70 and the delayed monocytosis ( $r=0.36$ ). Blood concentration of  $\mu\text{CRP}$  was stable the first 6 h after exercise, but was progressively increasing during the next 22 hours (from  $0.7 \pm 1$  to  $2.3 \pm 0.5$  mg/l). There was no correlation between changes in HSP 70 levels and  $\mu\text{CRP}$  levels ( $r=0.07$ ). The workout resulted in delayed granulocytosis and monocytosis and a moderate increase in blood HSP 70 levels. There was no significant correlation between individual changes in HSP 70 levels and the magnitude of the delayed monocytosis. The acute phase protein

CRP and probably also HSP 70 (Febbraio et al 2002) are secreted by the liver, but there was no correlation between plasma concentrations of HSP 70 and CRP.

In a further analysis we will continue the search for possible monocyte mobilizing agents.

Asea A et al (2000). *Nat Med*, vol 6, 435-442

Febbraio MA et al (2002). *J Physiol*, vol 544, 957-962

Walsh RC et al (2001). *Cell Stress Chaperones*, vol 6, 386-393

O122J-6

**Influence of different training amounts on the mechanical and neuromuscular parameters of the stretch shortening cycle****Bubeck Dieter, Sialis Ionnis, Gollhofer Albert**

University of Freiburg, Germany

*Keywords: stretch-shortening cycle, neuromuscular adaptation, training load*

The purpose of our study was to clarify the effects of different training amounts on the performance parameters and neuromuscular activation patterns at the drop jump (DJ).

30 athletes participated in this 4-weeks training study. They were divided into two training groups, performing DJ's with different types of loading: Group "intensive" - low volume and high intensity, group "extensive" - high volume and lower intensity.

In the intensive training group (ITG) the input caused a slight increase of the ground reaction force, a slight reduction of the contact time and an increase of the flight time. The extensive training group (ETG) showed clear reductions of the ground reaction forces, increases of the contact times and reductions of the flight times from the pre- to the posttest. This lead to sig. increases of the jump performance indicator (reactivity index (RI) = flight time / contact time) at the ITG and sig. reductions of the RI at the ETG. The activation characteristics of the analysed anti gravity leg muscles showed a non significant tendency to earlier phases of the main activity at the ITG. Compared to that, the neuromuscular changes at ETG could be characterised by a shift to later phases of the main activity. The main activity occurred at the RIA and the LER phase.

The changes of the mechanical performance parameters of the SSC suggest that during the short duration of the four training weeks adaptations occurred mainly in the neuromuscular system. The changes in this system could be partly observed by the left shift of the main IEMG activity at the ITG respectively the shift to the right at the ETG. Following the results of Gregory et al. (1998) it can be assumed that this higher PRE, LAT and RIA values lead to a higher stiffness of the leg muscles, which can be seen by the reductions of the angle amplitudes at the ankle and knee. Contrarily, the extensive – high volume DJ training causes, due to the intraserielle exhausting training volumes, a kind of fatigue which leads to submaximal jump performances during the training session, which leads to changes of the general movement patterns of the SSC during the training process. In conclusion, it could be maintained, that performance of a high volume and low intensity training type results in negative effects on the jump performance at DJ's.

Gregory JE et al (1998). *J of Physiology* 513(3): 927-934

O122J-7

**Relationship between maximal exercise performance and changes in cerebral/muscle oxygenation/blood volume measured by near infrared spectroscopy****Bhambhani Yagesh, Ram Maikala, Mamdouh Farag, Rowland Gary**

University of Alberta, Canada

*Keywords: cerebral oxygenation, muscle oxygenation, maximal exercise capacity*

Near infrared spectroscopy (NIRS) is a noninvasive optical technique used to evaluate oxygenation and blood volume changes in cerebral and muscle tissue. In cerebral tissue, changes in oxygenation reflect neuronal activation, whereas in muscle tissue they reflect the balance between oxygen delivery and utilization during exercise. Research suggests that cerebral hypoxemia may be a contributing factor that limits maximal exercise performance. This study examined the relationship between indices of maximal exercise performance and changes in: (1) cerebral oxygenation (Cox) and blood volume (Cbv), and (2) muscle oxygenation (Mox) and blood volume (Mbv) in healthy men.

Informed consent was obtained from 12 volunteers (mean  $\pm$  SD for age, height, body mass and VO<sub>2</sub>max = 26.6  $\pm$  7.6 yr, 1.76  $\pm$  .05 cm, 80.5  $\pm$  10.5 kg and 41.5  $\pm$  4.2 ml/kg/min respectively) who completed incremental cycle ergometry (30 Watts/2 min) to voluntary fatigue. Cardiorespiratory responses were monitored using a metabolic cart and a wireless heart rate monitor. A dual wave NIRS instrument was used to simultaneously measure Cox and Cbv from the left frontal lobe and Mox and Mbv from the right vastus lateralis. The cardiorespiratory and NIRS data were averaged every 20 sec for analysis. For each subject delta values of the NIRS variables were calculated as the maximum or minimum values minus the baseline value prior to exercise.

Cox and Cbv increased with exercise intensity until maximal oxygen uptake (VO<sub>2</sub>max) was attained. In contrast, Mox decreased systematically (ie. greater release of oxygen from oxyhemoglobin/oxy-myoglobin) with increasing exercise intensity, with a leveling off towards VO<sub>2</sub>max. However, Mbv increased until approximately 40% to 60% of VO<sub>2</sub>max and then leveled off or decreased until VO<sub>2</sub>max was attained. Significant correlations ( $P < .10$ ) were observed between absolute power output vs Cox ( $r = 0.51$ ) and Cbv ( $r = 0.49$ ) as well as absolute VO<sub>2</sub>max vs Cox ( $r = 0.47$ ) and Cbv ( $r = 0.48$ ). The correlations between the measures of maximal exercise capacity and Mox/Mbv were negative but not significant ( $P > .10$ ).

The opposite trends in Cox and Mox measured simultaneously during incremental exercise support earlier research. These findings suggest that maximal exercise performance is more closely associated with central neuronal activation rather than peripheral muscle oxygenation or blood volume status during cycle exercise in healthy men.

## Oral Session

### Physical Education/Physiology

O122K

O122K-1

#### Health-enhancing physical education and lifelong participation: a sociological perspective

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*Keywords: health, lifelong participation, sociology*

A broad consensus has emerged in recent years in relation to the desirability of one particular purpose for physical education in the UK: namely, the promotion of lifelong participation in sport and physical activity.

How this might be best achieved is keenly disputed. Government, the media and sports governing bodies, as well as many teachers themselves, appear to view sport, and particularly team games, as the primary vehicle for promotion of ongoing involvement in health-promoting, active lifestyles. By contrast, many academics recommend a re-orientation of PE towards health-related exercise and the kinds of 'lifestyle activities' increasingly favoured by adults.

The paper explores the propensity of contemporary PE to facilitate the kinds of active lifestyles likely to endure throughout the life-course. It argues that the study of sports participation from the perspective of the 'natural' sciences (and most notably psychological perspectives) has tended to restrict our understanding of participation patterns by failing to take into consideration the broader dimensions of adults' lives, beyond their individual motivations and attitudes towards exercise and sport.

Grounded in recent sociological work on the changing nature of the transition from childhood to adulthood in the 'Western world' and the associated 'new condition' of youth, the paper considers the place of sport and physical activity in young people's lives. In doing so, the paper examines the implications of both a preoccupation with sport as a vehicle for health promotion, as well as the apparent dismissal of a sporting orientation in PE, in the light of what we are coming to know about young people's lifestyles and leisure and sports participation patterns.

The paper concludes that it is only when one views participation in sport and physical activity 'in the round' that one is likely to appreciate the manner in which a repertoire of activities more neatly matches young people's preferences - for activities they can do as and when they want, with whom they want and where they want - that one appreciates how multi-activity programmes, incorporating but not exhausted by sports activities, best suits youth's new condition.

O122K-2

#### More than a coach? Athletes' expectations for their coaches

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*Keywords: coaching, expectations*

A coach usually wants to be a good coach. The image of a good coach varies. Studies of coaching have mostly concentrated in training and competition situations. Despite the emerging idea of holistic approach in coaching there are

very few studies about athletes' opinions about what is important in coaching.

The aim of this study was to find out athletes' expectations and experiences of their coaches. The athletes in this study, 264 in all, represented 38 different sports, from club-level to international level. They were asked to write a story about their coach. The stories were analysed by using a qualitative method.

Coach's role is, no doubt, to enhance performance. This includes knowledge about the sport and training methods and also factors like authority, fairness, dedication and demanding way of coaching which help an athlete to concentrate on training. Some athletes want their coach to be "just a coach". This means that he is an expert and his social skills are sufficient.

Most of the athletes in this study expect more of their coaches. Some of them describe their coaches as educators. A coach is an example and often he is given a role of a parent. The role of an educator is highlighted in adolescent. There are a lot of descriptions of discussions in athletes' stories. A coach is considered as "more than a coach" if the athlete feels that he can talk about anything with his coach. A coach is special if he had time and is willing to discuss about matters outside sport. The feeling that the coach cares seems to be a result of small things. The coach smiles, asks your feelings, winks his eye or the athlete just feels that the coach is there for you and helps you to succeed.

Most of the athletes in this study have great expectations of their coaches. A coach is considered an expert despite the level of his education. He might feel uncertain about his expertise and this might, at its worst, lead to excessive authority or pretended expertise. The interaction between an athlete and a coach is stressed in this study.

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O122K-3

#### Preliminary analysis of middle and high school students' experiences in mixed-sex physical education classes with body and gender concerns

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*Keywords: physical education, gender, body*

The purpose of this study was to report preliminary analysis of female and male students' perceptions of participating in mixed-sex physical education within the discourses of gender relations and bodily experiences as a part of a wider, ongoing study on the effectiveness of single-sex and mixed-sex physical education classes.

The data was collected from two mixed-sex public middle and high schools that represent middle socio economic status. Data was collected by means of focus group as a qualitative method. A total of focus groups was conducted with seventh and eight grade (13 to 15 years of age) female and male

students. Each focus group was consisted of six students and took approximately 1-1.1/2 hours. The content analysis method of qualitative analysis was used to analyze data. The data obtained from each focus group was sorted into gender relations and body experience themes.

With respect to the theme of gender relations, the majority of male students and some of female students' perceptions seem to support traditionally biased gender role stereotypes regarding gender propriateness of physical activities. In addition, many of female students were disappointed with their participation in physical education because physical education curriculum consists of traditionally male activities such as basketball and soccer, where boys dominated. Regarding to the theme of body experiences, female students expressed negative bodily experiences and a sense of body control regarding to their physical appearance, movements and clothing from both female and male teachers and male friends.

In conclusion, this study illustrates the need for a continued emphasis on gender relations and body experiences in mixed-sex physical education classes.

#### O122K-4

### Maximal leg oxygen uptake during whole body exercise - effect of training

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*Keywords: endurance training, muscle, oxygen uptake*

Despite extensive research over the last 70 yrs it is still debated whether muscle VO<sub>2</sub>max is determined by the cardiorespiratory system's ability to deliver oxygen or by the muscles capacity to utilize oxygen. The purpose of the present study was to examine the effect of training on muscle oxygen uptake during high intensity whole body exercise.

Five subjects aged 23 (20-25) yrs, 66 (59-74) weight kg and VO<sub>2</sub>max 59 (50-72) ml/kg\*min trained one leg 4 times pr week in 7 weeks. Mean training volume was 1150 (600-1800) kJ/week, a workload of 90 (75-115) W corresponding to 70 (65-76) % of maximal heart rate. After the training period, both legs were tested simultaneously on a cycle ergometer at a workload corresponding to 91±2.2% (mean±SD) of VO<sub>2</sub>max until exhaustion (7±1 min). With visible feedback from strain gauges at the crank arms, subjects kept power output equal in both legs. From catheters in one artery (brachialis) and both vena femoralis, blood samples were drawn after 3, 4 1/2 and 6 min of exercise. Blood flow was determined by a thermodilution technique, simultaneously in both vena femoralis, immediately after blood samples were drawn. Skeletal muscle VO<sub>2</sub> was calculated from arterial venous difference and leg blood flow.

The maximal pulmonary oxygen uptake did not change during the training period. Four out of five subjects had higher oxygen uptake, 3 subjects had higher blood flow and all of the subjects had larger a-v O<sub>2</sub> diff in the trained leg. There were no statistical differences.

The subjects in this study were moderate to highly endurance trained. Four out of five subjects had a higher oxygen uptake during exhaustive bicycling in the trained leg compared to the untrained leg. The subject who did not achieve a higher oxygen uptake in the trained leg, was the subject with the highest maximal oxygen uptake (72 ml/kg\*min). The preliminary data suggests that training increases leg oxygen uptake during maximal whole body

exercise in moderate endurance trained subjects. This indicates that peripheral factors affect maximal muscle oxygen uptake even during whole body exercise.

#### O122K-5

### Evaluation of the stress induced by the rappelling activity

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*Keywords: physical stress, sympathetic nervous system, rappelling*

Adventure sport activities are often performed in order to decrease the physical and mental stress. However, these called "adrenaline sports" can also induce physical stress. The aim of this work was to study the intensity of physical stress induced by a rappelling activity and its influence in somatic anxiety, preoccupation and perturbation of concentration.

Fourteen students of the Faculty of Sport Science and Physical Education participated in a rappelling activity (descending) of a 20 m wall. In order to assess physical stress, plasma catecholamines and platelet serotonin were measured. The cardiovascular effect was evaluated by the heart rate measured by the Polar system. An anxiety test (AED-anxiety scale in sport) was applied to the subjects to assess somatic anxiety, preoccupation and perturbation of the concentration. The following body measures were also taken: height and body weight, to calculate the body mass index (BMI). The analysis of the differences was performed by a multivariate analysis (ANOVA) followed by a post-hoc test (student's t-test).

The mean (±SD) age was 19.7 ± 1.2 years and the BMI 22.4 ± 2.1 Kg/m<sup>2</sup>. The anxiety dimension with the highest values was the somatic anxiety (2.5 out of 4.0 marks). As we can see in the table above there was an increase in blood catecholamines and heart rate while rappelling. 30 minutes rest after the exercise were not sufficient to replace basal levels of catecholamines and heart rate. However, the practice of rappelling leads to a significant decrease in 5-HT levels.

The increase of heart rate before the rappelling activity illustrates the increased state of stress felt by individuals and shows the activation of the sympathetic nervous system. A rise in plasma serotonin and catecholamines may lead to a higher vascular contraction, which may cause a rise of blood pressure. This may emphasise the disadvantage of the practice of this type of modalities (rappelling activity) in order to relax. However, we cannot discard an adaptation by the repeated performance of this practice, decreasing with time the synthesis of catecholamines and 5-HT. As an advantage of the rappelling practice we can indicate its possible anxiolytic effect.

O122K-6

### An electroencephalographic investigation of brain activity associated with fatigue during static exercise

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University of Cape Town, South Africa

**Keywords:** *fatigue, EEG, isometrics*

The purpose of this study was to investigate brain areas or circuits associated with fatigue during an isometric exercise. Nineteen subjects of varying physical activity levels participated in this study. An electroencephalographic (EEG) recording (128-electrode) was obtained during rest with the subjects eyes open. Subjects then performed a maximal isometric knee extension (MVC) and, after resting, an isometric sub maximal (20% MVC) knee extension until they could no longer maintain the 20% force output. EEG was measured during the sub maximal fatigue test and the data normalised to the resting state measurements. The data was divided into five frequency bands for analysis - theta (4-8Hz), alpha1 (8-10.5Hz), alpha2 (10.5-13Hz), beta (13-20Hz) and gamma (20-40Hz). Electromyographic (EMG) measurements were taken during the sub maximal test and normalised to measurements from the maximal test. EEG and EMG data were expressed over ten time periods (each reflecting 10% of the time to exhaustion) to show changes in brain and neuromuscular activity with time. Changes in EEG power were calculated relative to time period one of the fatigue test, so, as to reflect only fatigue-related changes.

Subjects lasted an average of  $188 \pm 57$ s during the fatigue test. During this time the EMG amplitude increased significantly ( $p < 0.01$ ) and the EMG frequency decreased significantly ( $p < 0.01$ ). There were significant increases in power from the first time period in the theta, alpha1 and beta bands for many brain regions during the fatigue test. The regions showing this increased activity were different between the frequency bands. There were no significant increases in power between time period one and any of the following time periods in the alpha2 and gamma bands.

The theta, alpha1 and beta frequency bands show different patterns of activity with increasing fatigue and appear to represent different neural circuits with specific functions and incorporating many brain regions. Increases in theta and alpha1 activity are consistent with memory and visual processes. Beta activity suggests internal vocalisation and activation of brain areas signalling homeostatic distress, with right hemisphere domination in the final stage of the trial consistent with negative avoidance behaviour and a decision to terminate the task.

cardiorespiratory function in Saudi young males, and examine tracking coefficient over an 11-year period.

Subjects were 31 young males from a predominantly middle-class with good nutritional status. They were tested twice, at baseline (T1), with a mean age (SD) of 9.5 (1.5) years, and at a follow-up test (T2), with an average age of 20.5 (1.7) years. Graded treadmill running protocol with a constant speed and an incremental elevation was used. An open-circuit spirometry system was utilized for respiratory and metabolic data collection.

Paired samples t-test indicated significant increases in body mass (150%), lean body mass-LBM (120%) and fat percent (66.5%) from T1 to T2. There were no significant changes between T1 and T2 in maximal heart rate ( $197 \pm 6$  vs  $200 \pm 8$  bpm), VO2 max relative to body mass ( $48.4 \pm 6.1$  vs  $48.3 \pm 7.9$  ml/kg.min), or VO2 max relative to LBM ( $57.6 \pm 8.2$  vs  $62.0 \pm 10.4$ ). However, there were significant increases at T2 compared with T1 in VO2 max relative to body surface area-BSA ( $1.84 \pm 0.23$  vs  $1.38 \pm 0.24$  L/min.m<sup>2</sup>), and in O2 pulse index ( $6.99 \pm 1.14$  vs  $9.18 \pm 1.14$  ml/bpm.m<sup>2</sup>). In addition, VO2 max scaled to 0.67 or 0.75 of body mass increased significantly by 20% and 29%, respectively. Ventilatory anaerobic threshold (VAT) relative to body mass decreased significantly from T1 to T2 by 13%. Furthermore, Pearson correlation analyses of cardiorespiratory function relative to body mass revealed considerably low tracking coefficients over the 11-year period, ranging from 0.056 for VO2 max relative to body mass to 0.269 for maximal heart rate.

It can be concluded that VO2 max relative to body mass remained almost the same from childhood to young adulthood in Saudi males. However, VO2 max expressed relative to BSA or raised to body mass to the power of 0.67 or 0.75 increased significantly during the same period. Furthermore, Tracking of cardiorespiratory fitness over an 11-year-period from childhood to young adulthood was low.

O122K-7

### Longitudinal assessment of cardiorespiratory function in Saudi youth: An 11-year follow-up study

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**Keywords:** *tracking, cardiorespiratory fitness, VO2max*

A number of research studies indicate that contrary to a short period of time (5 years or less), tracking of cardiorespiratory fitness from childhood to young adulthood over a longer period declines considerably. Therefore, the purpose of this study was to present follow-up data on maximal



## Poster Session

## Rehabilitation 1 – Physiotherapy 1

P12M

## P12M-01

**The role of sports science in neurological rehabilitation**

Kotzian Stefan, Pelikan Julia, Musil Ulrike, Simon Nina, Aimet Martin, Spiesberger Reinhard, Brandl Josef, Rupp Monika, Zifko Udo

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*Keywords: rehabilitation, neurology, sport therapy*

The aim of this report is to point out the role of sports science based interventions in neurological rehabilitation. Various studies proved the efficacy of sports therapeutic interventions such as strength training, and endurance training and its role for improvement of functional performances. But sports therapy has still not been sufficiently established yet.

To show the importance of sports therapeutical interventions in a comprehensive rehabilitation program we collected data from all patients who came to the Clinic Pirawarth within one year and compared data from the first medical check up and the sports therapeutical basis diagnosis with the further classification, according to sport science specific goals, into individual therapy programs. The prescript type of therapy was determined by the primary and secondary diagnosis, the patient specific deficits, the therapy goal, the transferability and risk factors.

85% of all in 2001 enrolled patients (n=2240, female 1050, male 1190, aged 64,5 (7-94) years, Barthel Index 65;) with neurological primary diagnosis (Stroke 65,5 %, Multiple Sclerosis 8,2 %. Neuromuscular disorders 5,2 %, M. Parkinson 4 % and others) and 4851 secondary diagnosis (53,6 % Hypertension, 18,5 % cerebrovascular diseases, 17,8 % diabetes mellitus, and others) were prescribed to a sports therapeutic basis diagnosis after a medical check up at reception.

For 77 % (n=1725) from all patients sport therapeutic approaches have shown to be indicative for improvement of aerobic capacity and/or strength and/or coordination skills. The patients were classified into 2831 therapies. 328 patients were not sent to sport therapeutic check up and in 187 cases, sport therapeutic approaches were not prescribed because of functional limitations. The most frequent assigned interventions were: aerobic training (1001), strength training (718), training of coordination skills (654), mixed endurance and strength training therapies (128), and therapies with the goal of relaxation (24).

These data show the importance of sports science based approaches because of the frequency of interventions based on goals for improvements in functional performances and in the psychosocial wellbeing. The authors suggest that sport therapeutic interventions can be very valuable to complement the conventional rehabilitation team with its particularly defined aims.

*All data published are taken from Clinic Pirawarth report 2001*

## P12M-02

**Controlled dynamic strength training improves muscle strength during a stationary rehabilitation program after stroke**

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Clinic Pirawarth, Austria

*Keywords: rehabilitation, strength training, stroke*

The question posed in this study was whether strength training on weight machines, applied for a limited time (4 to 6 weeks stationary rehabilitation program in a clinic), can lead to an improvement in muscular strength and whether low intensity or high intensity training is more preferable.

57 stroke survivors who participated in a rehabilitative stay in a clinic 3±2 month after stroke were recruited. The subjects were randomly assigned into a low intensity group (LI), (15 male, 6 female, 66±11years) exercising 3 sets of 20 to 30 repetitions with 50 % of ORM and into a high intensity group (HI), (15 male, 14 female, 66±11 years) exercising 3 sets with 8 to 12 repetitions with 70 % of ORM. 7 Patients (1 male, 6 female, 63±11 years) who did not attend strength training on training machines served as no exercise control group (NE). To participate in the study the patients had to exercise on the leg press to strengthen their leg extensor muscles. Both groups trained 2 to 3 times a week for 30 minutes. To determine the tolerability of the two training methods a modified questionnaire (B-L) was used. Their range of exertion was asked by using the BORG scale (1 to 10). Barthel Index (BI) and walking test (10 meter walking test and ten seconds walking test) were also assessed in some cases (n=8).

Significant improvements of bilateral muscle strength were found in both training groups (LI: p<0,01 and HI: p<0,001). There were no significant improvements of muscle strength found in the control group. The HI group showed higher bilateral increases in ORM (p<0,05) than the LI group. Both training methods were well tolerated and the exertion was in the LI group (RPE score 3), in the HI group (3,5). The evaluation of the questionnaires showed no significant differences in group specific tolerability. The BI (BI < 100) increased in each case (p<0,001). Walking distance meanly increased by 14 meters, significant (p<0,05), and walking time decreased by 1 second, not significant. During training no associated gains in spasticity were noticed.

This study shows that a 4 to 6 weeks strengthening program during a rehabilitation stay is effective to increase muscle strength and in accordance to other studies it can be assumed that it is effective to improve the quality of life in stroke survivors. High intensity training should be the preferred training method.

## P12M-03

**The effect of massage (passive physiotherapy) on blood hyper- and hypotension****Valuziene Nijole, Mikelkeviciute Jurate**

Lithuanian Academy of Physical Education, Lithuania

*Keywords: blood pressure, massage*

Massage has a therapeutic effect and appropriate massage can have the effect on encephalon, cardio-vascular, respiratory and other systems as well as on pelvic organs and legs. Blood pressure aberration from increasing to reduction gives cause for unpleasant sense and possibility to evolve serious complications. Notwithstanding the positive effect of massage on blood pressure is known, the effect was based on empirical research, what indicated the use of massage together with medicament treatment. Testing was used for evaluation of blood pressure of 47 subjects.

The massage technique and methods were based on massage principles described by J. Finkelsteinaite, N. Valuziene and J. Damanskas (1995).

The findings indicated that massage led to significant reduction of systolic and diastolic blood pressure for subjects with increased (hyper) blood pressure ( $p < 0.05$ ) and the significant changes in systolic blood pressure of subjects with reduced blood pressure ( $p < 0.05$ ), but there was no significant improvement in diastolic blood pressure of the subject after the experiment ( $p > 0.05$ ).

## P12M-04

**Intrarater reliability of knee flexion measurement and knee laxity measurements in uninjured subjects and in patients after ACL reconstruction****Mustalampi Sirpa, Kiviranta Ilkka, Selänne Harri**

LIKES Research Center, Finland

*Keywords: knee*

The aim of this study was to investigate intrarater reliability of knee flexion measurements using goniometer and knee laxity measurements using KT1000 arthrometer in uninjured subjects and in patients after anterior cruciate ligament (ACL) reconstruction.

Thirtyfive subjects volunteered for this study. The ACL reconstruction group consisted of fifteen subjects (5 female and 10 male; mean age of 26.6 yrs). Anterior cruciate ligament of these subjects had been reconstructed 3 to 12 months before the tests. The uninjured group consisted of twenty healthy subjects with no lower extremity musculoskeletal injuries (10 female and 10 male; mean age of 31.4 yrs). The maximum active and passive knee flexion angle of the subjects was measured in both limbs with a standard mechanical goniometer. The knee laxity was measured with a KT1000 instrument (MEDmetric® Corp., San Diego, USA) according to manufacturer's guidelines. The used force was 134 N. All subjects were retested three days later. The same experienced physiotherapist made all measurements. The results were evaluated with intraclass correlation coefficient (ICC), coefficient of variation (CV%) and with paired T-test.

The paired T-test did not reveal differences between test and retest in any of the measurements. All ICCs between test and retest were statistically significant ( $p < 0.001$ ). ICCs of active knee flexion measurements were 0.92 and 0.94 and ICCs of passive measurements were 0.83 and 0.87 in

dominant and non-dominant limb, respectively, in uninjured subjects. ICCs of active knee flexion measurements were 0.85 and ICCs of passive measurements were 0.90 in both limbs in patients after ACL reconstruction. CVs in active and passive measurements varied from 0.6 to 0.7 % in uninjured subjects and from 0.8 to 1.3 % in ACL group. ICCs of knee laxity measurements in uninjured subjects were 0.91 and 0.94 and CVs 6.8 and 6.2 % in dominant and non-dominant limb, respectively. The corresponding results in ACL group in unoperated and reconstructed limbs were: ICCs 0.96 and 0.95, CVs 3.7 and 4.1 %.

The intrarater reliability of goniometric and KT1000 measurements varied from good to excellent. The results are in agreement with earlier studies. Range of motion measurements using standard goniometer and knee laxity measurements using KT1000 arthrometer provide reliable and useful information during rehabilitation after ACL reconstruction.

## P12M-05

**Aquatic therapy for improving empowerment of autistic children (Part 2)**

**Sugi Kanako, Yamaguchi Hidetaka, Takahashi Kouki, Amaoka Hiroshi, Uoran Baik, Ishimoto Yasuko, Kosaka Taeko, Nose Yuka, Nishimura Kazuki, Nakanishi Youhei, Matsuda Sinsyou, Ishii Kyoko, Hayashi Shikako, Hoshijima Yoko, Matsui Takeshi, Nishimura Masahiro**  
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*Keywords: questionnaire, autistic children, aquatic therapy*

It is known that autistic children have three characteristic disorders; social skill, communication skill and particular behaviors. Consequently, it has been considered that autistic children are difficult to join in group activities. However, it requires consideration whether aquatic therapy such as mass education produces good results for autistic children or not. The purpose of this study was to clear the effects of mass education in aquatic therapy of autistic children using questionnaires about their parents.

Seventeen autistic children (6-14 year old) and their parents served as subjects. This program was carried out over three terms from May 2002 to March 2003. The 1st term encompassed seven sessions (May-July); the 2nd term, six sessions (October-December); the 3rd term seven sessions (February-March). We distributed questionnaires to their parents and collected it at the end of the session. Parents made entries in the questionnaires at will. It was divided into categories (Changes at home, Changes at school, and Changes at aquatic therapy). After aquatic therapy, many effective changes at home. We considered that it was formed of the mass education of autistic children to pay attention for individual children. Accordingly, it is satisfactory to consider that it is very important for staff of aquatic therapy to grasp individual behavior pattern and to give individual assistance to the autistic children.

In conclusion, it suggests that mass education of aquatic therapy is effective to improve individual daily life.

## P12M-06

**The hip abductor activation pattern in hip arthroplasty patients**

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**Keywords:** *hip arthroplasty, EMG activity, hip abductor*

The present study examined the hip abductor activation pattern of patients with a single hip arthroplasty by measuring surface EMG onset and cessation times.

Fourteen total hip replacement (THR) patients (56-72yr) and ten age and sex matched healthy volunteers (Ctrl) participated in the study. Postoperative gait analysis evaluated stride characteristics, surface EMG from bilateral gluteus medius and 3D pelvis kinematics. Bipolar surface electrodes were used to sample EMG activity during treadmill ambulation at self selected walking speeds (2.4 - 4.5km/h). EMG onset times were normalized with regard to the individual stride time (% stride) for each gait cycle. The ZEBRIS ultrasound movement analysis system was used to track (50Hz) three ultrasonic markers attached to the posterior midline of the sacrum (S1).

Repeated measures ANOVA (group x body side) revealed significant EMG onset differences ( $p < .001$ ) in comparing hip abductors of the operated side ( $1.1 \pm 4.2\%$ ) with the unimpaired side ( $96.9 \pm 2.2\%$ ) and the healthy controls (left  $95.6 \pm 3.8\%$ , right  $95.3 \pm 2.2\%$ ). Additionally the analysis revealed significant differences ( $p < .01$ ) for stance duration THR: operated  $58.1 \pm 6.8\%$ ; non-operated  $65.2 \pm 3.9\%$  vs. Ctrl: right  $64.8 \pm 2.7\%$ ; left  $64.6 \pm 2.8\%$ ) and sagittal pelvis range of motion (THR:  $4.9 \pm 1.4^\circ$  vs. Ctrl:  $3.3 \pm 0.4^\circ$ ).

Even though the patients in the present research experienced only moderate pain intensities at the time of testing, their hip abductor activation pattern was marked by a significant out-of-phase activity probably adopted when these subjects had severe painful osteoarthritis in the joint. The changes in stride characteristics are consistent with those of other authors (McCrory et al. 2001), who also found that hip arthroplasty patients walk with a considerable asymmetry of stance times. The increased anterior-posterior pelvic tilting, seen in the current investigation, might probably compensate for limited hip motion during walking.

The out-of-phase activity could have impact on the physiological loading of adjacent structures. Moreover, atypical gait patterns could increase the risk of injury and falls. Further analysis should focus on possible ways of therapeutic interventions and explore whether rehabilitation programs can address the altered muscle firing pattern.

McCrory et al (2001). *Gait Posture* 14: 104-109

## P12M-07

**Changes of functional status and quality of life of hip arthroplasty patients after in-patient rehabilitation**

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**Keywords:** *quality of life, hip arthroplasty, functional status*

Remaining deficits after rehabilitation with respect to health related quality of life and all-day motor competence in patients with prosthesis of the hip were described. The purpose of the study was to examine short term changes of generic health status, motor function and balance after in-

patient rehabilitation in a group of patients who underwent total hip arthroplasty.

The study population consisted of 30 female hip arthroplasty patients (age  $68.8 \pm 8.9$  years) who underwent a primary unilateral total hip replacement (surgery indication: degenerative arthritis of the hip). All subjects had been operated and treated in different hospitals and subsequently performed an in-patient rehabilitation program for  $23.3 \pm 4.0$  days within one rehabilitation clinic. In a longitudinal prospective study design the German version of the SF-36 and 3 functional tests for the assessment of functional mobility (Frankfurt Street Crossing Test, FSCT) and balance (Berg Balance Scale, BBS; Timed "Up & Go"-Test, TUG-Test) were administered at rehabilitation discharge as well as 3 and 6 month post rehabilitation. Repeated measures ANOVA were calculated to examine differences between measurements ( $p < 0.05$ ).

Compared to basic values at rehabilitation discharge the analysis revealed significant increases in five SF-36 subscales. Concerning the 3 functional tests for the assessment of functional ability and balance a continuous significant reduction of the time [s] needed to accomplish the task of the FSCT and TUG-Test could be observed. Furthermore the score of the BBS increased significantly over time.

Steady improvements throughout the study period could be shown in generic health status, motor function and balance after in-patient rehabilitation. This work also supports the use of these instruments to assess the functional status after total hip arthroplasty. In future studies attention should focus on patients' every day activities.

Berg K et al (1992). *Can J Pub Health, Suppl. 2: 7-11*

Podsiadlo D et al (1991). *JAGS 2, Vol. 39: 142-48*

Pfeifer K et al (2001). *Dtsch Z Sportmed 52, Vol. 4: 129-35*

## P12M-08

**Influences of neck position and visual afferents on cardiac autonomic activity during diagonal shoulder resistance exercise**

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Hung Kung University, Taiwan

**Keywords:** *shoulder resistance exercise, cardiac autonomic activity, neck position*

Diagonal shoulder resistance exercise (DSRE) is commonly used to improve activities of daily living in neural lesion patients. To provide more sensory inputs, it usually combines neck movement and visual afferents during DSRE. However, there are conflicting data concerning the influences of neck position and visual inputs on cardiovascular system. The aim of this study was to evaluate the role of the neck position and visual following with hand on the cardiac autonomic activities during DSRE.

The heart rate (HR) and mean artery pressure (MAP) were continually measured through electrocardiography and indirect blood pressure monitor. A power spectrum was used to analyse the fluctuations of the heart rate variability (HRV), a marker of cardiac autonomic activities, in 13 healthy male subjects (mean age  $21.3 \pm 1.5$  yr). DSRE protocols were 30% of 1 RM, 30 repetitions per minute for four minutes. The subjects were assessed for HRV during the following four experimental conditions in balance order. The four trials were (1) neck in midline with eyes closed (NMEC), (2) neck in hyperextension with eyes closed (NEEC) to activate otoliths and neck muscle afferents, (3) neck in midline with visual following with hand (NMVF) to activate visual afferents, or (4)

neck in hyperextension with visual following with hand (NEVF) to activate otoliths, neck muscle and visual afferents. There are no significant influences of neck position or visual following with hand on the HR and MAP in four trials. HRV had 6.5 and 11.1% respectively increased the normalized high-frequency power (HFnu) during NEEC and NEVF than NMEC ( $P<0.05$ ) and the normalized low-frequency power (LFnu) was decreased by 6.7, 2.6 and 6.4% respectively during NEEC, NMVF, and NEVF than NMEC in recovery stage ( $P<0.05$ ) Table 1.

Our results indicate that the cardiac sympathetic nerve activity is significantly altered by NEEC and NEVF in recovery stage, suggesting the influences of the otolith organs, neck and visual afferents on autonomic modulation of the heart. For neuroanatomical pathways that exist between the vestibular, visual and cardiovascular systems of animals, we speculate these reflexes also are powerful activators of cardiac autonomic nerve regulation during dynamic exercise in humans.

Ray CA et al (2002). *Clin Exp Pharm & Physio* 29: 98-102

Jian BJ et al (1999). *J Appl Physio* 86: 152-6

### P12M-09

#### Specific changes of postural behaviour of children with MBD after goal-directed water exercises

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**Keywords:** water exercise, minimal brain dysfunction, stabilometry

This work solves how regularly and goal-directed water exercises can influence the postural behavior of children with minimal brain dysfunction (MBD).

7 children between 6 and 8 years old, who had been regularly swimming therapy once a week - 45 minutes each - were chosen. There was an exploration before and after every therapy, which consisted of the standing body posture, picked motoric tests and scanning the excursions centre of pressure by the force contact pressure platform (FCPP).

The analyses showed positive effects of swimming pool therapy for the children's postural system and also for the MBD symptoms. The improvement of motor functions wasn't found at all parameters which were checked. The significant changes came on general movements, coordination of movements and hyperactivity parameters.

The evaluation of graphic recordings of dynamic effects of COP and measured values on the FCPP indicate the decision making about the improvement or impairment of stage (succeed therapy) can't be done only on interval of maximal or minimal values of oscillation, but it is necessary to monitor the other parameters of movement COP too. Even though the improvement was not shown in all expectant arguments, we evaluated the therapy as applicable and advantageous. We hope that our job will help to improve the methodology of swimming pool therapy and bring new information to all, who deal with the minimal brain dysfunction problems.

### P12M-10

#### Non-invasive capillary and subcapillary blood flow measurement over acupuncture points (Gb21)

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**Keywords:** acupuncture points, microcirculation, Laser Doppler Spectroscopy

Acupuncture Points (AP) show several anatomical and physiological peculiarities (Heine 2001) which indicate a specific elevated microcirculation. AP are closely correlated to musculoskeletal pain points (MPP), e.g. trigger points. The AP 'Gall bladder 21' (Gb21) is prevalently affected by MPP (Melzack et al. 1977). MPP do not only provoke decreased local blood flow values but also induce microcirculatory indispositions and painful disorders in distant muscles (Simons 1996). Nevertheless, the capillary (cBF) and subcapillary (sBF) blood flow over AP has not yet been established by non-invasive measurements. The reliable ( $r=0.83$ ,  $p<0.01$ ) (Ghazanfari 2002) and valid Laser Doppler Spectroscopy (O2C) allows for the first time a direct, real time and non-invasive detection of the local cBF and sBF. The purpose of this randomised cross-sectional study is the non-invasive evaluation of cBF (depth: 1mm) and sBF (depth: 8mm) over AP (Gb21) to prove a characteristically increased microcirculation over AP.

In 28 subjects ( $41.1 \pm 9.8$  years) the glass fiber probes of the O2C were placed over Gb21 and an adjacent asymptomatic reference point (RP) at the trapezius muscle. The relative blood flow was measured over a period of three minutes in each case. Microcirculation comparisons over AP and RP were made using MANOVA.

The results showed significantly higher sBF compared to cBF over Gb21 ( $F=89.95$ ,  $p<0.01$ ) and RP ( $F=88.47$ ,  $p<0.01$ ). A significantly higher microcirculation was evaluated for all subjects over Gb21 compared to RP (cBF:  $F=7.35$ ,  $p<0.05$ ; sBF:  $F=8.56$ ,  $p<0.01$ ).

The employment of the O2C permitted for the first time a non-invasive evidence of a significantly increased cBF and sBF over AP (Gb21). This evaluation of the initial microcirculatory state of AP could be the basis for following acupuncture studies. Furthermore, this methode might improve the diagnostic standards of MPP. Further research should concentrate on assessing the microcirculatory effects of physical therapy treatments. Increased blood flow values according to exercise may lead to released muscular tension and decreased pain in the affected muscles.

Ghazanfari M (2002). *Phys Med Rehab Kuror* 12: 330-336

Heine H (2001). *Dtsch Ztschr Akup* 3: 168-175

Melzack R, Stillwell DM, Fox EJ (1977). *Pain* 3: 3-23

Simons DG (1996). *J Musculoskel Pain* 4 (1/2): 93-121

## P12M-11

**Exercise performance in high and moderately trained heart transplant recipients, untrained healthy subjects and patients with heart diseases**

**Pokan Rochus, Von Duvillard Serge, Ludwig Jutta, Rohrer Andrea, Hofmann Peter, Rödler Suzanne, Quittan Michael, Wonisch Manfred, Smekal Gerhard, Schmid Peter, Pacher Richard, Bachl Norbert**

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**Keywords:** performance, cardiac transplantation, blood lactate

A recommended component of heart transplant recipients (HTR) is endurance oriented exercise therapy (Bengel et al 2001; Renlund et al. 1996, Squires 1991). However, the trainability of HTR after transplantation is vague. We examined exercise performance of high-endurance trained HTR, moderately trained HTR, patients with documented heart diseases and sedentary healthy subjects (SHS).

We studied 8 groups of individuals, of those 5 groups were HTR. High-endurance trained (HTR-ET), moderately trained of normal weight (HTR-NW), obese (HTR-O), denervated (HTR-D), reinnervated (HTR-R), patients with coronary heart disease (CHD), dilated cardiomyopathy (DCMP) and SHS. Participants were subjected to cycle ergometer tests with load increments of 10, 15 and 20 Watts (W) every min until volitional fatigue. Respiratory gas exchanges measures and heart rate (HR) were determined and recorded continually. Blood lactate concentration (LA) was measured at the end of every increment and during 6 min recovery.

The HTR-ET achieved a significant best performance of 236±45 W and the highest VO<sub>2</sub>max of 40.2±7.5 ml.kg<sup>-1</sup>.min<sup>-1</sup> in contrast to all other groups. The HR measured during maximal power output in the HTR-ET was 164±9 bpm and similar to SHS, CHD and CMP, and significantly higher than HTR-NW (131±16 bpm), HTR-O (130±10), HTR-R (137±19) and HTR-D (124±19). The L<sub>A</sub>max of HTR-ET was 9.0±2.2, comparable to SHS (9.5±2.1) and CHD (7.3±2.3), and significantly higher than all other HTR and CMP.

Our data suggest that HTR can achieve exercise performance results that are comparable or exceed values of sedentary, or moderately trained healthy subjects.

Bengel FM, Ueberfuhr P, Schiepel N, et al. (2001). *N Engl J Med*;345: 731-738

Renlund DG, Taylor DO, Ensley DR, et al. (1996). *J Heart Lung Transplant*;15:16-24

Squires R.W. (1991). *Med Sci Sports Exerc*;23:686-694

## P12M-12

**Efficiency of postisometric relaxation on improvement of sacroiliac joints and iliac joints in subjects with of lumbo-sacral region pain**

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**Keywords:** lumbo-sacral pain, postisometric relaxation, physiotherapy

Spine complaints concern subjects in various age. Spondylosis and radiculo-discal conflict seemed to be the most frequent reason of spine pain. Aim of the study was to assess impact of postisometric relaxation (P.R.) technics in pelvic ligaments and selected muscles on improvement of the motoric function of sacroiliac and iliac joint.

20 women and 6 men between 34 and 77 yrs. with intensive sacro-lumbar pain took part in the study. Technics of P.R. were applied on selected ligaments and muscles of pelvis which are the most frequently irritated. Every day during the period of three weeks, following test were done before and after therapy: clinical test for functional estimation of pelvic ligaments and sacro-iliac joints, based on the position of spina iliaca disposal of pelvis, goniometric measurement of the range of move in knee and hip joints.

Results of the study showed that iliolumbar ligaments were the most frequently irritated in patients with sacral pain. Functional shortening and overloading of the ligaments from the left side of pelvis was also observed. Application of P.R. decreased significantly ( $p<0,001$ ) the frequency of pelvic ligamental syndromes. Lack of improvement only in some cases was observed. Significant limitation of movement in hip joints was seen in subjects with pain syndrome of lumbo-sacral region. Mentioned limitations concerned mostly extension, abduction, external and internal rotation of femur in the hip joint. Such tendencies were similar in both hip joints. Application of P.R. of selected muscles improved motor function in treated joints. P.R. of iliopsoas muscle provided the best results -26,8% increment of range of femur extension ( $p<0,01$ ). P.R. of femur abductors provided 10% increment of femur adduction

( $p<0,01$ ). On the other hand P.R. of piriform muscle did not change significantly internal rotation of femur in hip joint. Assessment of sacroiliac joints function by spine test showed an unilateral blockade in 70% subjects before and 20% after therapy.

Results indicate that lumbo-sacral pain may be a consequence of overloading of the structures situated in this region (sacro-iliac joints, ligaments, muscles). Treatment should be directed to restore static balance of pelvis in such cases. It restores proper length and resilience of soft tissues, relaxes excessive tensed muscles and improves mutual relations inside the joint. It leads to pain inactivation and improvement of quality of life.

## P12M-13

**The complex physiotherapy in patients with bronchial asthma**

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**Keywords:** physiotherapy, bronchial asthma, massage

Bronchial asthma is one of the most often occurring disease of the respiratory system. The difficult breathing related with asthma can cause increase of tension in respiratory muscles and disorders of ventilation. The purpose of this study was to estimate the influence of massage on some parameters of lung function and level of respiratory muscles tension in patients with bronchial asthma.

The study was done on 40 women with asthma bronchiale, who were treated pharmacologically. The individuals were divided into 2 groups: I experimental group (20 women), which were treated with massage of respiratory muscles for 5 days, II control group (20 women) without massage. In all the patients full lung function test was performed with the flowscreen of the firm Jaeger contains spirometry and flow-volume and measured: VC, FVC, FEV<sub>1</sub>, FEV<sub>1</sub>%VC, PEF. The estimation of respiratory muscles was done by pressure of muscles extremities and subjective estimation of pain level. Six point scale was used: 0 - no pain, 1 - slight pain, 2 - average pain, 3 - strong pain, 4 - very strong pain, 5 - nagging. The following muscles were tested: m.

sternocleidomastoideus, m. pectoralis major, m. trapezius, m. levator scapulae, m. rhomboideus, m. serratus anterior, m. pectoralis minor.

The analysis of the effects of massage on the performance of the respiratory system states that all the parameters of the experimental group increased, but VC and PEF are also statistically significant. There was also an increase in some parameters in control group, but not statistically significant. Comparison of both tested groups showed that there is a greater increase in results of the experimental group. Analysis of the effects of massage on the level of pain (tension) of respiratory muscles reported statistically significant reduce in experimental group. There was a statistically significant reduce of level of pain in control group. There are found statistically significant differences between experimental and control groups.

These results showed that massage can significantly reduce the tension of respiratory muscles and increase some parameters of lung function.

#### P12M-14

### Comparison of body posture in young and elderly physical active males

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#### Keywords

Ageing process is followed by deterioration of all the systems responsible for body posture control. However, in healthy and physically active elderly people the age-related decrease of sensomotoric system efficiency doesn't always result in significant changes of body posture. The objective of this research was to evaluate the shape of anterior-posterior curvatures of the spine and to determine the values of body symmetry deviations in frontal plane, in elderly males.

The experimental group consisted of 34 males aged 61-83 attending two hour-long training sessions a week. The comparative group included 30 students. For the evaluation of the size and shape of lordosis and kyphosis the Moire technique was applied. Whereas the value of thoracic kyphosis lower segment inclination was similar to the value obtained by young adult males. The stated differences indicate flattening of lumbar lordosis and deepening of upper arch of thoracic kyphosis, which results in a characteristic body posture in standing position with the head protruding and the upper trunk segment inclined. The assessment of body posture in frontal plane revealed a frequent occurrence of asymmetry in the area of trunk. Its size and localization were different in both groups. A vertical declination of spinous processes line was the most frequently observed moderate asymmetry in all the examined, yet in the elderly males it had a lower percentage. The asymmetry of waist trigones in elderly males was as frequently observed as the asymmetry of shoulders in younger males. Moderate asymmetry of the remaining assessed body segments up to some degree concerned the elderly males. Taking into account the occurrence frequency of significant asymmetry the analysis proved its higher percentage in the elderly males, excluding the parameter indicating the depth of waist incisure. The largest differences between the groups were observed in the position of shoulders waist and in the position of spinous processes in relation to the vertical plane.

Personal research carried out on a group of physically active elderly males did not show significant deviations in the shape of anterior-posterior spinal curvatures, characteristic for this age group. Irregular posture, clearly exceeding the accepted standards was not observed. Most probably this is a result of the life-time, systematic physical activity declared by the examined people, at present carried on in the form of organised physical exercise and individual physical activities.

## Poster Session

### Physiology 7 - Traumatology 1 – Rehabilitation 2

#### P12N

#### P12N-01

### Cardiovascular drift during prolonged high intensity exercise in hot-dry and hot-humid environments

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*Keywords: humidity, cardiovascular drift, prolonged exercise*

The cardiovascular responses to prolonged exercise are characterized with a drift over time referred to as "cardiovascular drift" which appears to be a result of both exogenous and endogenous heat loads requiring increased skin blood flow to dissipate heat. Although Nadel and colleagues (1979) reported a greater magnitude of CV drift with increasing ambient temperatures, to our knowledge there have been no investigations of the effect of relative humidity on CV drift which is the purpose of this study.

This present study observed a steeper rate of rise in  $T_{re}$ , resulting in a significantly higher  $T_{re}$  at the end of exercise in hot-humid (HH) compared with hot-dry (HD) environment ( $39.40C \pm 0.5$  vs.  $38.90C \pm 0.3$ , respectively). The  $T_{sk}$  in HH was significantly higher compared with the HD environment ( $32.920C \pm 0.88$  vs.  $31.400C \pm 0.68$ , respectively). However, within both HH and HD environment,  $T_{sk}$  was observed to

plateau from 30 to 60 minutes of exercise. Cardiac output remains relatively constant within both environmental conditions. A decline in SV was observed across time in both HH ( $139.54ml \pm 8.78$  to  $129.01ml \pm 8.68$ , 10 to 60 minutes, respectively) and HD environment ( $137.10ml \pm 14.34$  to  $114.09ml \pm 5.14$ , 10 to 60 minutes, respectively). Conversely, HR drifted upwards across time during exercise in HH ( $145.9bpm \pm 12.5$  to  $169.4bpm \pm 13.1$ , 10 to 60 minutes, respectively) and HD environment ( $144.0bpm \pm 12.4$  vs.  $155.5bpm \pm 12.8$ , 10 to 60 minutes respectively). A significantly higher tissue heat conductance was recorded in HH compared with the HD environment ( $155.52W.m^{-2} \pm 28.46$  vs.  $129.75W.m^{-2} \pm 16.03$ , respectively). The magnitude of CV drift was greater in the HH environment compared with the HD environment. A higher  $T_{sk}$  in the HH environment suggests a greater skin blood flow (SkBF) in this condition which may potentially compromise venous return and effectively reduce SV. However, there was no significant change in  $T_{sk}$  after 30 minutes of exercise, yet SV continued to decline in both environments which would suggest the decline in SV was not the result of an increased SkBF and that the increase in HR observed may be the primary determinant of CV drift (Fritzsche et al., 1999). This proposition however cannot be supported without more direct measures of SkBF.

In conclusion, this study has shown that in the HH condition the magnitude of CV drift is greater than in the HD condition although further research is needed to conclusively support or refute the work of Rowell (1974) and/or Fritzsche et al. (1999).

#### P12N-02

### Electromyographic evaluation of cervical spine muscle activation pattern

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**Keywords:** EMG, cervical spine, muscle activity

The purpose of the study was to enlarge the knowledge of the cervical spine muscles in stabilisation of the head while expected and unexpected accelerations and a sudden stop (simulated collision).

In a standardised testing procedure 10 healthy subjects ( $f=4$ ,  $m=6$ ; age  $25.2 \pm 1.2$  years) were accelerated sitting on a sled and followed by simulated collision (Magnusson et al. 1999). The unilateral surface EMG of the m. sternocleidomastoideus and m. trapezius pars descendens were recorded with 1000Hz/channel. The maximum occurring range of motion (ROM) of the head in the sagittal plane after the sudden stop was registered by a Penny & Giles goniometer. Before testing, the subjects were seated on a sled, positioned with an upright trunk, hip and knee were in a right angled position. In this defined neutral position they were fixed on the sled by a belt. In each trial the sled was accelerated up to 3.6 km/h ( $\sim 1$  m/s) before the sudden stop. The trial setting contained the acceleration/stop cycle forwards and backwards under the conditions expected and unexpected (without audio-visual stimuli), which were repeated three times in a randomised order. Between the measurements was a one minute period of rest. The average SEMG activity in the rest period and after the sudden stop was analysed to determine the onset of the muscles. The onset was defined as the exceeded current mean SEMG signal of the rest period (baseline) by three standard deviations (DiFabio et al. 1987). Students t-test for paired samples were calculated for differences between expected and unexpected condition ( $p < 0.05$ ).

The results revealed significant differences between values for expected vs. unexpected onset m. sternocleidom., onset m. trap. desc. and time of max ROM of the head. The maximum occurring ROM of the head in the sag. plane showed no sign. difference between expected and unexpected stops. Furthermore the results of all parameters showed high SD's.

The steady improvements do not support the existing of consistent neuromuscular activation pattern in cervical spine muscles and the hypothesis of muscle activation delay in unexpected backwards acceleration/stop cycles. The approved high SD's in the results of the present study indicates an obvious variability associated with intra- and inter-individual differences.

DiFabio et al (1987). *Phys. Ther.* 67:43-48

Magnusson et al (1999). *Eur. Spine J.* 8: 118-125

#### P12N-03

### Knee injuries in ice hockey - a series of 507 injuries

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**Keywords:** knee injuries, ice hockey, injury prevention

Ice hockey is in Finland one of the most popular sports today. There are about 60.000 registered players. Body checkings, striking with high velocity against the boards, contacts with other players, and blows by a stick cause a great number of injuries (see e.g. Lorentzon et al. 1988, Stuart & Smith 1995, Mölsä et al. 1997, Mölsä et al. 2000). Knee injuries accounted for 17% of all injuries documented in ice hockey in Finland during 1987-1991 (Kujala et al. 1995). The aim of this study was to analyse the mechanisms, types, and severity of knee injury in different age categories in Finnish ice hockey. We analysed in detail the documents of 507 cases of knee injury reported to Pohjola Insurance Company in 1996.

36% ( $N=182$ ) of injuries occurred during practices. Of the injured players, 7.5% ( $N=38$ ) were goalkeepers, and 9% ( $N=45$ ) were professional players. Most injuries occurred in players aged from 15 to 19 years ( $N=193$ , 38%), or in players aged from 20 to 24 years ( $N=99$ , 19%). The type of injury was patellar dislocation in 22 cases, meniscal tear in 59 cases, and total rupture of the AC ligament in 22 cases. However, the most common type of injury was sprain of the ligaments ( $N=345$ , 56%). As a mechanism of injury, body checking was involved in 28% of cases, and/or collision with the boards was involved in 17% of cases. Falling caused 33% of injuries. Without any collision between players, 93 (18%) injuries occurred. Those injuries causing absence from practices or games of 28 and more days, were classified as major injuries ( $N=146$ , 29%). Operative treatment was carried out in 144 (29%) cases of knee injuries.

Knee injuries in ice hockey are relatively serious. Preventive measures, such as further development of protective equipment and rule changes, should be tested to lower the risk of knee injury.

Kujala UM et al (1995). *BMJ* 311: 1465-8

Lorentzon R et al (1988). *Am J Sports Med* 16: 392-6

Mölsä J et al (1997). *Am J Sports Med* 25: 495-9

Mölsä J et al (2000). *Am J Sports Med* 28: 322-7

Stuart J, Smith A (1995). *Am J Sports Med* 23: 458-461

#### P12N-04

### Aquatic therapy for improving empowerment of autistic children (Part 1)

**Kosaka Taeko, Yamaguchi Hidetaka, Takahashi Kouki, Amaoka Hiroshi, Uoran Baik, Sugi Kanako, Ishimoto Yasuko, Nose Yuka, Nishimura Kazuki, Nakanishi Youhei, Matsuda Sinsyou, Ishii Kyoko, Hayashi Shikako, Hoshijima Yoko, Matsui Takeshi, Nishimura Masahiro**

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**Keywords:** autistic children, aquatic therapy, empowerment

The concept of hydrotherapy for autistic children is based upon the improvement and development of motor learning skills and personal relations between the children and their family members. Hydrotherapy has had a good effect upon aquatic exercises for autistic children. We have started aquatic therapy programs for autistic children to promote their individual needs since April 1, 1999. The following is a case study of hydrotherapy for autistic children. The purpose of

this program is to promote the development of psychological awareness and social skills for autistic children.

Twenty-two children and their parents participated. One leader and about twenty assistants took care of them in the water and out. Water temperature was  $30.2 \pm 0.4^\circ\text{C}$  and room temperature was  $25.5 \pm 1.6^\circ\text{C}$ . This program was carried out over 3 terms from May 2002 to March 2003. The 1st term encompassed 7 sessions (May ~ July); the 2nd term, 6 sessions (October ~ December); the 3rd term 7 sessions (February ~ March). All activities were recorded on video. They were evaluated in 3 stages [can not participate: 1, can participate with help: 2 or can participate: 3.] We analyzed the video and checked the children's activity in order to verify this program. We obtained informed consent with participating members. The aquatic therapy program consisted of first gathering and exchanging greetings. This was followed by warm up, splashing the kids with water, playing in the pool with parents and assistants, circuit training, kick training, resting time, group and individual activity, aqua aerobics, cooling down and exchanging good byes. Most of the children got something out of the program. Figure 2 shows a typical example of how a child was affected by circuit training. As for sliding, going through the hoop, crossing the balance beam, picking up a ring, going through the tunnel and throwing three balls, the evaluation changed from can participate with help to can participate, from can not participate to can participate with help, from can participate with help to can participate, from can participate with help to can participate with help, from can participate to can participate and from can participate to can participate, respectively.

It was considered that a society of children was improved by the medium of these programs. Children could communicate with staff while playing in the pool. It suggests that aquatic therapy is effective for improving individual empowerment.

#### P12N-05

### Effects of unilateral dynamic strength training in female patients with multiple sclerosis

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**Keywords:** strength training, multiple sclerosis, neurological rehabilitation

The aim of this pilot study was to evaluate the effect of unilateral dynamic strength training of the lower extremity on female patients with multiple sclerosis.

34 female multiple sclerosis patients (age:  $49.5 \pm 12$  years, height:  $166 \pm 6.6$  cm, BMI  $24.2 \pm 3.7$ ) were selected to strengthen their leg muscles on a leg press. At the beginning and at the end of a 4-week stay for a neurologic rehabilitation the strength levels were evaluated with a One Repetition Maximum Test (ORM) on the training equipment. Patients absolved the ORM Test with the left, the right leg and both legs. Twice a week the patients absolved low intensity dynamic strength training with a resistance of 40 % of the ORM with the weak leg. We also look for a difference between chronic progressive (C-MS  $n=15$ ) and relapsing MS (R-MS  $n=19$ ) in muscle strength. It was possible to train the patients in accordance with principles of training known from sport science. The training was tolerated by patients and they showed no muscle tone increase.

The unilateral strength training significantly increased maximum muscle strength of the leg extensor muscles in both groups together, (both:  $93 \pm 30$  kp to  $100 \pm 33$  kp,

$p < 0.05$ ; weak leg:  $35 \pm 10$  kp to  $40.5 \pm 13.2$   $p < 0.01$ ), in R-MS (both:  $96 \pm 31$  kp to  $105 \pm 29$  kp,  $p < 0.001$ ; weak leg:  $36 \pm 11$  kp to  $43 \pm 15$   $p < 0.001$ ). In C-MS we can find a significant reduce ( $p < 0.01$ ) between the weak and the stronger leg in pre ( $18.6 \pm 13.3$  kp) and post ( $13.6 \pm 10.3$  kp) test.

The results of this investigation indicate that low intensity (40 % ORM) dynamic unilateral strength training is an useful and well tolerable method to increase muscle strength of weak leg by patients with multiple sclerosis. We also can show that there are positive effects on the outcome of both legs. The R-MS patients showed no decrease in side difference. Therefore we have to question why a difference between C-MS and R-MS is found and how a goal-directed training should look like.

#### P12N-06

### A case study on aerobic exercise for type 2 diabetes using an arm crank ergometer in a wheelchair-dependent patient with ossification of the posterior longitudinal ligament (OPLL).

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**Keywords:** immersion, type II diabetes, arm crank

It is known that the morbidity rate of type 2 diabetes wheelchair-dependent patients is high. Researchers agree that the amount of activities available to wheelchair-dependent patients is not enough to maintain everyday cardiovascular system health. Generally, aerobic exercise induces an increase in aerobic work capacity, muscular power, the quality of life (QOL) and the activity of daily living (ADL). This is also presumed to apply to wheelchair-dependent patients. Although aerobic exercise is difficult for wheelchair-dependent patients, exercise, using an arm crank ergometer, is an effective exercise method. Therefore, we have started an ergo therapy program using the arm cranking ergometer for wheelchair-dependent patients with Ossification of the Posterior Longitudinal Ligament (OPLL) and type 2 diabetes. This program has been in effect since Oct 30, 2002.

The subject was a 41 year old female who had morbidity type 2 diabetes and was a wheelchair-dependent patient with OPLL. Her disability occurred as paralysis in the lower limbs of her body. She was injecting insulin; the insulin unit was 30 per day. Her daily food intake was 1,200 kcal per day. The subject was instructed to perform training of the upper arm using the tube everyday (morning; 20counts, afternoon; 20counts). The subject was instructed how to use the arm cranking ergometer (Monark Rehab Trainer 881E, MONARK co.) by the research staff weekly. Arm cranking ergometer exercise was performed in the state of pediluvium. The subject and institution gave informed consent before participating.

Plasma glucose decreases after the ergo therapy was implemented. In performance, insulin unit decreased from 30 to 16 per day. The rotational speed and total rotational frequency of the arm cranking ergometer improved.

These results suggest that an ergo therapy program using the arm cranking ergometer for wheelchair-dependent patients was effective for type 2 diabetes. It is important to note that the subject was looking forward to the weekly ergo therapy program. This suggests an ergo therapy program improvement in QOL for the subject. The program continues to this day.



P12N-07

### Beneficial effects of physical activity in combination with hormonal therapy for breast cancer patients: Histological reactions in the DMBA-breast cancer model

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**Keywords:** physical activity, breast cancer, hormonal therapy

Many studies concerning physical activity and cancer focus on the preventive potential to fall ill with breast cancer. Mechanical effects include changes of the estrogen and progesterone profiles. Both hormone profiles influence the estrogen and progesterone receptor expression and therefore the success of an (anti-)hormonal treatment in the therapy of breast cancer. Therefore, we investigated the influence of voluntary exercise on breast tumor growth and examined histologically hormonal receptor status and proliferation behaviour in the tumors.

Tumor bearing animals started voluntary training for 4 weeks after a palpable tumor size. We determined the tumor weight and examined the estrogen- and progesterone-receptor (ER; PR) status of the tumors as well as the proliferation marker PCNA by using immunohistochemistry.

Compared to the control group, physical activity led to a slightly reduced tumor weight in highly active rats. All tumors showed a malignant and invasive growth behaviour. With the exception of two carcinomas all tumors were ER+ and PR+. Two carcinomas were ER+ and PR- and belonged to the group of highly active rats. Histological differentiation of the tumors showed ductal papillary (DP) and ductal cribriform (DC) carcinoma types. All cribriform types belonged to the voluntary exercising group. In the highly active rats the immunohistochemical factor PR-heterogeneity had a distinct value in comparison to the ER. The comparison of the DP and DC carcinoma groups showed a significant decreased IRS values (immune reactive score) for both ER and PR in the DC-group. The analysis of the PCNA proliferation marker showed no alterations and we could not detect a correlation between PCNA score and tumor weight.

In conclusion, our results demonstrate that physical activity does not lead to changes of the hormonal receptor status (ER, PR) in breast tumors and therefore do not affect a clinical endocrine therapy in both ways: positively or negatively. Furthermore, alterations of ER and PR are apparently not aetiological or mechanistic factors for a decreased tumor growth due to physical activity.

P12N-08

### A multi-station proprioceptive exercise program in patients with bilateral knee osteoarthritis: functional capacity, pain and sensorimotor function

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**Keywords:** osteoarthritis, proprioception

The purpose of this study was to investigate the effects of a 6 weeks multi-station proprioceptive exercise program that is easy to integrate in home-exercise program, on functional capacity, knee pain, and sensorimotor function in patients with bilateral knee osteoarthritis.

Twenty-two patients, who volunteered, with grade 2-3 bilateral knee osteoarthritis were randomly assigned to two groups: training (TR, n=12, 9 women and 3 men) and non-treatment (NONTR, n=10, 7 women and 3 men). The training group patients performed a multi-station exercise program, which included 11 different balance/coordination and proprioception exercises, twice a week for 6 weeks. Functional capacity (rising from a chair, walking, stair climbing and descending) and knee pain during rest and activities, peak torque of knee muscle groups (at 0°, 60°, 120° and 180°/sec of angular velocities) of subjects were tested before- and after- 6 weeks period. In addition, knee position sense (active and passive at 20°, 45° and 70° of flexion) and kinesthesia (at 45° of knee flexion), and postural control (Romberg, single leg and tandem tests, eyes open and closed) of subjects were tested before and after 6 weeks. Following the exercise program, in training group, knee pain at night, rising from a chair, walking, stair climbing and descending decreased 64% (p<0.01), 59% (p<0.05), 56% (p<0.05), 60% (p<0.01) and 56% (p<0.01) respectively. The time for rising from a chair, stair climbing and descending improved 12% (p<0.05), 21% (p<0.01) and 5% (p<0.05) respectively. Position sense at 20° (0°=full extension) improved 28% (p<0.01) and 34% (p<0.05) for active and passive tests, respectively. A 38% (p<0.05) and 36% (p<0.05) improvement were observed for passive position sense at 45° and for active position sense at 70° respectively. Position error at 15° and 30° of knee flexion improved 50% (p<0.05) and 51% (p<0.01), respectively, for weight bearing test. Eyes closed postural control also improved 208% (p<0.01) and 164% (p<0.01) for single leg and tandem tests respectively. While concentric knee extensors peak torques were not changed following the program, isometric torque increased 48% (p<0.05). However, non-treatment group did not display these marked changes following the 6 weeks period.

The results suggest that with a multi-station proprioceptive exercise program used in the present study, it is possible to improve functional capacity, postural control and decrease pain in patients with bilateral knee osteoarthritis.

P12N-09

### Sensorimotor control in ACL reconstructed knee: one year follow-up

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**Keywords:** proprioception, ACL, balance

The purpose of this study was to determine the effect of a rehabilitation program on sensorimotor control of ACL reconstructed knee.

Data of twenty-one male patients, who underwent arthroscopic anterior cruciate ligament (ACL) reconstruction using bone-patellar tendon-bone autograft, were reviewed. The patients went through an accelerated rehabilitation program (5 days in a week for 4 months), which included balance and postural maintenance activities following the first month of the surgery. For static balance activities, the patients progressed from bilateral to unilateral activities, from activities with eyes open to those with eyes closed and from those performed on a stable surface to those performed on unstable surface. These activities followed the progression from static balance activities to dynamic skill activities. Assessments were made by joint position sense (angular velocity=1°/second, index angles = 20°, 45° and 70°, active and passive) and single-limb balance (on a soft surface, eyes open and closed) tests at 1st, 2nd, 3rd, 4th, 6th, and 12th

months of the reconstruction. Four functional tests (single hop for distance, timed hop, triple hop for distance and cross-over hop for distance) were added at 2nd month to the assessment. To compare injured and uninjured leg results Wilcoxon signed rank test was used.

Mean time to first touchdown values of single-limb balance test was significantly ( $p < 0.01$ ) different between both legs at each follow-up period. Only at 1st month the mean number of touchdowns of the injured leg was significantly ( $p < 0.01$ ) higher when compared with uninjured leg. Injured and uninjured leg comparisons for joint position sense showed significant differences at the 1st month for the index angles at  $20^\circ$  ( $12 \pm 7^\circ$  versus  $10 \pm 6^\circ$  for active test,  $p < 0.05$ ) and  $45^\circ$  ( $4 \pm 4^\circ$  versus  $8 \pm 5^\circ$  for passive test,  $p < 0.01$ ). The results of functional tests revealed significant ( $p < 0.05$ - $0.001$ ) low values for injured leg compared to uninjured leg at each follow-up time. However, the deficit in percentage between both legs was lower than 20% after 4 months of the rehabilitation for the functional tests (31-46% at 2nd month, 24-34% at 3rd month, 18-23% at 4th month, 15-20% at 6th month and 7-13% at 12th month).

The results of this study indicated that the sensorimotor control of ACL reconstructed knee might improve, getting close to normal, by an accelerated rehabilitation program as used in this study.

#### P12N-10

### The physical-kinetic control of minimal posttraumatic effusion of knee and suprapatellar bursitis in athletes

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**Keywords:** physical control, knee joint, bursitis

We assess the effect of a physical-kinetic program given an individually attended treatment, in terms of pain, physical function and quality of life (QOL) for athlete patients with knee pain syndrome - posttraumatic effusion of knee (PEK) and suprapatellar bursitis (SPB).

We took into consideration 20 athletes with unilateral knee pain syndrome (12 men, 8 women, median age of 18 years, range 16 - 22), recently diagnosed. All patients had clinical and functional evaluations and imagistic investigations (sonography and standard X - ray) and were included and randomly assigned into two groups (each of 10 patients; the group A of PEK athletes and the group B of SPB athletes).

Sonographic examinations of the knees were performed in transverse and longitudinal sections, using a Siemens scanner with a 7,5 MHz linear array transducer.

Both groups were daily (14 sessions) treated with educational-pharmacological-electrotherapy methods. We supplied kinetic and massage methods. Patients were evaluated before rehabilitation and after 2 weeks.

Also both groups improved in pain and quality of life, the differences between mean score values (visual analogue scale score for pain and especially the Spitzer scale score for QOL) were statistically significant better in the second group. Suprapatellar bursitis responded more rapidly at physical-kinetic treatment than posttraumatic effusion of knee caused by soft tissue damage.

Posttraumatic injury of knee is a frequent condition in athletes and causes variable knee effusion with disability of the quadriceps muscle (particularly the oblique portion of vastus medialis).

The regain of kinesthetic awareness and knee stabilisation requires training and co-ordination of the muscle in the area and must be included in the rehabilitation program.

Functional electric stimulation coupled with quadriceps self-stretching represents a biofeedback-like method that can be easily applied.

Sonography represents a non-invasive and relative inexpensive method used in evaluation of knee pain syndrome, thus allowing an early therapy onset. This method gives useful information about knee structure alterations.

#### P12N-11

### Recovery of quadriceps femoris muscle after autologous chondrocyte transplantation in the knee

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**Keywords:** rehabilitation, autologous chondrocyte transplantation, m. quadriceps femoris

Cartilage lesions in the knee have limited healing potential and may cause prolonged joint disability with an impaired thigh muscle function, especially the quadriceps femoris. Autologous chondrocyte transplantation (ACT) has been accepted as a routine clinical procedure as a treatment of focal cartilage lesions in the knee. It is based on the ex-vivo cultivation of autologous chondrocytes which are later implanted into the cartilage lesion with an open-knee procedure. Implanted cartilage reaches its final firmness at one year. A post-operative rehabilitation protocol requires a 7 to 9 week restrain from full weight-bearing of the operated leg. After that period a gradual return to full range of activities is possible (running is allowed at 6 to 9 months; demanding knee activities at one and half year). The aim of the present study is to assess the recovery of quadriceps femoris muscle of the operated leg quantitatively.

Ten subjects treated with the ACT (height  $178 \pm 6.2$  cm, mass  $82.8 \pm 11.5$  kg) participated in the study. They performed tests on both legs, where non-operated leg was considered as a control. The measurements that were performed 14.1  $\pm$  8.4 months after the operation included knee torque during maximal voluntary isometric knee extension (MVC), level of voluntary activation of quadriceps femoris muscle during MVC, and its contractile characteristics. MVC and twitch torque were measured isometrically at 45 degree knee angle. The activation level was measured with twitch interpolation technique. The twitch was elicited by single supra-maximal electrical impulse to the femoral nerve. Differences between both legs were tested with Wilcoxon test for dependent samples. Level of statistical significance was set to 5% alpha error.

No statistically significant differences were found in MVC ( $238.7 \pm 56.5$  Nm operated leg versus  $247.0 \pm 51.7$  Nm control,  $P = 0.7989$ ), maximal twitch torque of relaxed muscle ( $42.9 \pm 12.4$  Nm versus  $47.3 \pm 10.2$  Nm,  $P = 0.2411$ ), or in muscle activation level assessed by twitch interpolation technique ( $76.9 \pm 14.6$  % versus  $83.9 \pm 10.6$  %,  $P = 0.1688$ ).

Results showed almost complete recovery after the surgery, since the operated leg in most patients displayed slightly lower potentials. The MVC torque and voluntary activation level are comparable to normal subjects. The successful recovery of the quadriceps femoris muscle has proved the ACT procedure and post-operative rehabilitation protocol ensure a good function of the operated knee.

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## P12N-12

**The effects of active recovery and rest on blood lactate levels and heart rate after intensive training of elite swimmers****Ramezani AR**

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*Keywords: lactate, swimming, recovery*

The purpose of this study was to compare, the decrease in blood lactate (LA) concentration alterations during various intensities. The effects of active recovery and rest on intensities of two kind of active recovery (30-45% & 55-65% of record of 100 freestyle) from highly intense exercise with rest recovery. Subjects were 20 healthy physically active and elite swimmers of National teams, 12-20 years old, were organized in two equal groups (10). The most important parameters that subjects were selected were, their 100 freestyle record, doing formal competition for 2-4 years and answer to the special questionnaire. Lactate was measured during both active and rest recovery following a maximal 100m freestyle sprint. Rest consisted of 15 min sitting in a comfortable chair and active recovery consisted of a 15 min swim with 30-45% & 55-65% of the best freestyle records. Capillarie blood samples were obtained from their lobe ears. Before and after of 100 sprints swim and in 15th min of recovery time for two kinds of recove. These data suggested that intensive swimming training may prevent or delay by active recovery compared with that passive one.

## P12N-13

**Is splenic contraction in breath-hold apnea active contraction or passive collapse?****Eterovic Davor, Bakovic Darija, Valic Zoran, Vukovic Ivica, Obad Ante, Marinovic-Terzic Ivana, Dujic Zeljko**

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*Keywords: ultrasound, spleen response, breath-holding, diving*

In many terrestrial and aquatic mammals, including humans, spleen contains a significant volume of a thick blood, which is partly released to active circulation during increased physical activity or diving. However, human spleen contains relatively few adrenergic fibers and it was suggested that spleen volume changes following an increase in sympathetic activity representing a passive collapse, rather than active contraction.

We tested this hypothesis in apnea diving by measuring the diving induced changes in spleen volume, arterial inflow and venous outflow. Three trained apnea divers underwent a single apnea dive with face immersion in cold water, lasting 150 seconds. The spleen volume and blood flows were measured ultrasonographically at baseline, during apnea, and after apnea, up to the full recovery of spleen volume.

The blood flows in splenic artery and splenic vein were not significantly affected by apnea diving. The spleen started to decrease immediately after the onset of apnea, reaching about 75% of baseline volume at 150 seconds at the end of apnea. This response was simultaneous with transient increase in heart rate (followed by more pronounced

decrease, a nadir before the apnea and subsequent increase towards baseline), while oxygen saturation started to decline in the third quarter of apnea duration. The recovery phase was slower and it took about 8 minutes for the full spleen volume recovery, unlike much faster restoration of heart rate and oxygen saturation.

These results show the fast, probably active contraction and slow relaxation of the human spleen in response to breath-hold diving.

## P12N-14

**Leading of the sportsman of mental readiness to responsible competitions****Malkin Valeriy**

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*Keywords: mental, readiness*

The practice of sports shows that frequently sportsman (team) lose to weaker rival in the most responsible competitions from insufficient mental readiness. Therefore skills to lead to peak of mental readiness is a primary factor of successful performance in responsible competition. The difficulty of this task is that the sportsman can be no more than 3-6 days on peak of mental readiness.

For this task the technology of leading the sportsman (team) to the peak of mental readiness in concrete competition was created. As a basis for this technology the principle "Regulation of mental pressure" in training was with appropriate preparation used in competition. As the basis for the given principle to lead the sportsman to the peak of mental readiness the thesis about necessity and opportunity of adaptation of regulation mechanisms of mentality was applied to extreme conditions of activity (responsible competition). In extreme conditions the regulation mechanisms frequently give failures as they are not ready to function optimal in conditions of significant mental pressure. It was assumed that consecutive regulation of mental pressure in training as a preparation for competition will allow special regulation mechanisms to prepare for those significant mental loadings.

The use of the given technology has shown that exactly in this component of the sports form the majority of the sportsmen reached optimum parameters of mental readiness before most important competitions. The data of mental readiness received before 3 final games European Goblet on volleyball before application of the given technology have shown, that only in 44 % of the cases the sportsmen were in a zone of maximal mental readiness (zone of mobilization and self-regulation). In 56 % of the cases the sportsmen were in a zone of an alarm, high excitation and insufficient concentration. The team reached place 4. The use of the given technology on the same competitions in the following competitive season has shown that before final games 83% of the sportmen were in a zone of maximal mental readiness. The team reached place 2.

The use of this technology on the basis of "Regulation of mental pressure" allows leading of the sportsman to the peak of mental readiness at the most responsible competitions.

## Poster Session

## Physiology 8 – Rehabilitation 3

P120

## P120-01

**Determination of correlation coefficients of lactate threshold indices and resting heart rate in elite runners****Hovanloo Fariborz, Faradjzadeh Mevaloo, Shahram**

Sport Science Research Center, Tarbiat Moallem University, Iran

*Keywords: lactate threshold, rest heart rate, long distance running*

The purpose of this study was a comparison of the resting heart rate values and lactate threshold indices, including running speed, running distance, heart rate, VO<sub>2</sub> and METs at lactate threshold (LT) in Iranian elite long & middle distance runners.

Resting heart rate of 12 elite, male runners [age: 23.7 yrs (1.81); body mass: 66 kg (1.45); height: 177.3 cm (1.42)] were measured. Then, the subjects were tested with Conconi test protocol on a Technogym treadmill.

Results of this study show high correlation coefficients between resting heart rate values and LT running speed ( $r = 0.997$ ), LT heart rate ( $r = 0.993$ ), LTVO<sub>2</sub> ( $r = 0.97$ ), LT running distance ( $r = 0.966$ ), & METs ( $r = 0.963$ ).

The results show very high correlation coefficients ( $r$ ) between resting heart rate and LT indices. Among the indices, LT speed values have the highest scores. This finding can be due to a close relationship between RHR and aerobic capacity in athletes that helps them during high performance in competition and takes good results.

Jansen Peter (2001), *Lactate Threshold Training*

Morgan D.W. and Daniels G.T. (1994): *Int J Sport Medicine* 15: 426-429

## P120-02

**Quality control of various ergospirometric measuring parameters by means of a gas exchange simulating system****Kusch Martin, Vogt Anke, Hoffmann Uwe**

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*Keywords: validation, gas exchange, quality control*

Quality control is significant for valid results in metabolic gas exchange measurements. The inherent variability of human breathing makes it difficult to assess the quality of breath-by-breath (BxB) gas exchange analysis. Several gas exchange simulation systems (GESS) have been developed to simulate gas exchange and to control quality of metabolic measurements (Gore et al. 1997; Prieur et al. 1998). Previous studies mainly focussed on the O<sub>2</sub>-uptake and the CO<sub>2</sub>-output (Keskinen et al. 2002; Kusch et al. 2002). They now aimed to have a closer look onto different primary measuring parameters like expiratory tidal volume (V<sub>t</sub>) and single breath duration (t<sub>b</sub>).

The GESS was used to simulate different expiratory volumes (V<sub>t</sub>: 0.5-2.9 l), respiratory frequencies (fr: 10-60 b/min), gas fractions (O<sub>2</sub>: 16-18 %; CO<sub>2</sub>: 3-5 %) and O<sub>2</sub>-uptakes (V<sub>O<sub>2</sub></sub> ca. 0.1-6.0 l/min). Measurements were obtained by connecting the GESS directly with a portable metabolic cart (Ergospiro 680, zAn, Germany). A position sensor allowed

monitoring the stroke volumes of the GESS and these data were used to calculate the simulated gas exchange as in the metabolic cart software. Agreement between GESS expiratory values and metabolic cart readings was evaluated by Passing-Bablok regression analysis and differences were tested by ANOVA.

GESS V<sub>O<sub>2</sub></sub> and V<sub>CO<sub>2</sub></sub> values were highly correlated with the cart results ( $r > .995$ ). Especially the excellent correlations between breath durations and between expiratory tidal volumes ( $r > .996$ ) are responsible for these results. However, somewhat greater deviations were observed for volume flow rates in excess of 9 l/s, which were due to an overestimation of V<sub>t</sub> at high ventilatory frequencies ( $fr > 50$  b/min).

The present testing procedure can be used to assess the validity of BxB devices. We conclude that the portable metabolic cart tested can be considered as a valid instrument for measuring pulmonary BxB gas exchange parameters within a wide physiological range.

Gore et al (1997). *Med Sci Sports Exerc* 29(8): 1095-1103

Prieur et al (1998). *Eur J Appl Physiol* 78: 549-554

Keskinen et al (2002). *IX World Symposium Biomechanics and Medicine in Swimming, St-Etienne, France*

Kusch et al (2002). *Proceedings VII anual congress of the ECSS, Athens*

## P120-03

**Physiological responses to water exercise: A comparison between swimming and deep water running****Benelli Piero, Ditroilo Massimiliano, Giacomini Francesco, Galli Monica, Stocchi Vilberto**

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*Keywords: water exercise, fitness activity, mid-age*

Water exercise has grown more and more popular in recent years. Besides traditional sport activities such as swimming, water polo, etc, and traditional fitness activities such as water running and water aerobics, new water activities have emerged, e.g. water bike and aquastep. These are sometimes used as alternative training methods in specific periods of the year's training plan. The aim of this paper is to evaluate the physiological responses in a group of swimmers from the Italian Master division (over 35-40 years) to two different water exercise techniques.

Ten swimmers were chosen. They typically trained three times a week and had previously been trained in deep water running. They were asked to perform three kinds of exercises: T1 = 10 minutes continuous at 60-70% of H.R. max; T2 = 1'30" repeated 10 times at 80-85% of H.R. max, 30" of rest; and T3 = 1'30" at full-out effort. All the exercises were performed with two different techniques: S = swimming and DWR = deep water running, six exercises altogether. However, only five of them reached the goal. The subjects were equipped with a heart rate monitor (Polar Vintage, by M & M). Moreover, capillary blood was taken from the finger tip. Blood lactate (mM) was analysed by Lactate-Pro. Lactate was measured after the performance in T1, after the 5th and the 10th trial in T2, five minutes after the end of T3. Furthermore, the athletes were asked to self-assess their

fatigue by means of the Borg rating of perceived exertion (RPE) Scale. They have previously been trained at using the Borg Scale.

There were no significant differences in lactate, heart rate and RPE values for exercises T1 and T3 when comparing swimming and running. However, we found a significant difference both in lactate and heart rate values for the exercise T2. More research in this area is needed in order to better understand the physiological responses to water exercise performed under different conditions. It appears that in particular periods of the year's training plan, different water activities, because of their various physiological responses, can be suggested to athletes as alternative methods to their usual training activities.

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#### P120-04

### Beta-blockers may provoke oxygen desaturation during submaximal exercise at moderate altitudes

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**Keywords:** exercise, beta blocker, moderate altitude

Information about the cardiovascular responses to exercise at high altitude in persons under chronic beta-blockade is scarce.

We studied 8 volunteers with chronic beta-blockade and 8 matched controls without beta-blockade. Subjects performed a submaximal step test at the bottom station of a cable car at 1480 m and at the top station at 2311 m after ascending by cable car. Arterial oxygen saturation, heart rate, blood pressure and the ratings of perceived exertion were measured during the test. Values are presented as means (SD). Mean values were compared using paired and unpaired t-tests, Wilcoxon-test or Mann-Whitney-U-test. Correlation coefficients were calculated by Pearson. A P-value <.05 (2-tailed) was considered statistically significant.

In persons taking beta-blockers arterial oxygen saturation was decreased ( $84 \pm 6\%$  vs.  $90 \pm 3\%$ ,  $P < .05$ ) and heart rate ( $120 \pm 17$  bpm vs.  $112 \pm 14$  bpm,  $P = .01$ ), rate pressure product ( $22192 \pm 6459$  vs.  $17576 \pm 4010$ ,  $P < .05$ ) and ratings of perceived exertion ( $14 \pm 3$  vs.  $12 \pm 3$ ,  $P < .05$ ) were increased during submaximal exercise at 2311 m compared to 1480 m. Subjects without beta-blockade did not show any changes. Furthermore, the changes in heart rate ( $+9 \pm 7$  bpm vs.  $0 \pm 10$  bpm,  $P < .05$ ) and ratings of perceived exertion ( $+2 \pm 1$  vs.  $0 \pm 2$ ,  $P < .05$ ) from the base station to top were different comparing persons with and without beta-blockers. In subjects under beta-blockade there was a strong negative association ( $r = -0.85$ ,  $P < .01$ ) between differences from 1480 m to 2311 m regarding arterial oxygen saturation and heart rate.

Only the subjects under beta-blockade showed arterial oxygen desaturation with a compensatory increase of heart rate, rate pressure product and ratings of perceived exertion during submaximal exercise at moderate altitude. Therefore, myocardial oxygen consumption and exertion are increased under these conditions. The stay of about 30 minutes at nearly 1500 m at the bottom station (parking, buying tickets etc.) could have developed a short-term ventilatory adaptation to high altitude which might be impaired by beta-blocker intake. If confirmed in larger controlled studies these findings would have important clinical and practical

implications because the exercise tolerance of persons under beta-blocker therapy might be reduced during acute high-altitude exposure.

#### P120-05

### EMG activity in the semitendinosus during gait, 6-months post anterior cruciate ligament reconstruction; a case study of a professional soccer player

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**Keywords:** EMG, ACL, gait

It has been estimated that more than 100,000 new anterior cruciate ligament (ACL) injuries occur each year (Bach and Boonos, 2001). Surgeons employ many different techniques for the reconstruction of the ACL; including the use of the semitendinosus tendon (Gulick and Yoder, 2002). Following surgery, rehabilitation should include the ACL graft harvest site. The aim of this investigation was to compare electromyographic (EMG) activity in the semitendinosus between the uninjured and injured limb of a professional soccer player six months after ACL reconstructive surgery.

The surgical procedure involved the use of the semitendinosus tendon from the injured limb to reconstruct the ACL. Testing took place on a PowerJog GX200 treadmill. The participant (aged 27 years) gave written, informed consent to participate in the study. Following skin preparation, bipolar active surface electrodes (DelSys Bagnoli-4 EMG system, US) were attached to the contracted belly of the semitendinosus of both legs. The EMG signal was differentiated and recorded to PC at 1024 Hz via an on-line, cabled DelSys Bagnoli-4 EMG system (US). EMG activity was recorded during 4 conditions: walking (5 kph), jogging (12 kph), running (17 kph) and sprinting (21 kph). Using EMGWorks software (Delsys, US, 2001) the results were filtered and processed by root mean squared (RMS).

The semitendinosus displayed normal levels and patterns of EMG activity in the injured limb (Whittle, 1996). The uninjured limb displayed a more random pattern of activity across all speeds and greater activity levels at lower speeds suggesting a technique difference between the two limbs. This may or may not have resulted from the injury and therefore caution should be taken when using the bilateral limb as the control. Further research in this area would benefit from synchronised EMG and kinematic data collection in order to analyse differences in technique.

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Whittle, M. W. (1996). *Gait Analysis an Introduction.*

#### P120-06

### Fast recovery of anaerobic power after short and long (Ironman) triathlon competitions

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**Keywords:** testosterone, triathlon, anaerobic power

The aim of this study was to determine the effects of long (3.8 km swimming, 180 km biking, 42.2 km running) and short (1.5 km swimming, 40 km biking, 10 running) triathlons on

anaerobic performance and serum testosterone concentrations after 48 hours of recovery.

Seven male triathletes (30.0 (5.2) yr; 178.9 (2.8) cm; 74.9 (3.0) kg) who completed an Olympic Triathlon (OT) and eight male triathletes (33.5 (8.4) yr; 174.5 (2.5) cm; 71.9 (2.4) kg) who completed the Lanzarote IronMan Triathlon (IT) participated in this study. Before and 48h after the triathlons jump tests (force plate), a Wingate tests, a body composition exam (DXA) and a blood sample for testosterone assessment were obtained from all subjects. The jumping height, the peak force (Pf) and the positive mechanical impulse (IMP+) were calculated from the force recordings during countermovement (CMJ) and squat (SJ) jumps. Later the anaerobic capacity during a Wingate test was measured with a SRM ergometer.

Body composition did not change 48h after the triathlons. Both groups decreased their vertical jump performance. In the OT group, jumping height decreased by 12% in squat jump, due to a lower positive mechanical impulse (IMP+) ( $p<0.05$ ). The CMJ was also deteriorated due to 8.8% lower peak force ( $p<0.05$ ). In the IT group, CMJ flight height was reduced by 10% ( $p<0.05$ ), also due to reduced IMP+ (3.5%,  $p=0.06$ ). No significant changes were observed in the SJ performance in the IT group. In contrast with the OT which did not affect, the IT competition caused a reduction of 4% in mean power during the Wingate test ( $p=0.06$ ). Forty-eight hours after the triathlons, testosterone concentration in serum was unchanged after the short triathlon, but decreased by 13% after the long triathlon ( $p<0.05$ ). No relationship was found between changes in testosterone and performance impairment after the competitions.

We concluded that despite the tremendous effort elicited by the Lanzarote Ironman Triathlon only minor changes in exercise performance were detectable, which were not related to the known decrease of serum testosterone after prolonged exercise.

#### P120-07

### Changes in anaerobic power and capacity in young soccer players after a 4-week break in training

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**Keywords:** anaerobic capacity, soccer, anaerobic power

The issue of influence of break in soccer players' training on the level of their physical capacity is still not well known. (Bangsbo J., Mizuno M. 1988) The objective of this study was to assess the influence of a 30-day break on the level of anaerobic capacity in 16-17-year-old soccer players with the use of Wingate test (WAnT).

The study group consisted of 15 soccer players (age of 17+-0.6, weight of 64+-5, height of 175+-3 cm). Anaerobic glycolytic power and capacity was assessed with the use of WAnT. The tests were carried out after the completion of league play-offs and in the first week of training period preparation for the new season. Ergometric parameters as well as the level of lactate concentration (LA) were measured.

The level of ergometric parameters dropped after 4-weeks break: maximum power (Pmax) by 3.41%,  $p<0.05$ ; total work performed (WTOT) by 2.57%,  $p<0.01$ . The value of maximum power drop index increased by 4.31%,  $p<0.05$ . There was no statistically relevant difference in increase of LA. There was correlation between Pmax and WTOT before and after the break, respectively  $r=.702$  ( $p<0.005$ ),  $r=.578$

( $p<0.01$ ) and LA  $r=.752$  ( $p<0.005$ ) recorded before and after vacation break in training sessions.

Analysis of results showed, that Pmax dropped by 3-5%; capacity described by WTOT and by time of power holding Pmax dropped by 2-3%; anaerobic capacity index - LA did not change statistically after 4-weeks break in training. Analysis of obtained data showed, that the 4-weeks break period in training sessions did not result in any significant changes in efficiency of anaerobic glycolysis mechanism at the level of adaptation to 30-second work in young soccer players. The observed decrease of ergometric parameters is probably a result of drop in effectiveness of mechanism responsible for energy supply for muscle work based on anaerobic alactic metabolism (ATP + PCr).

We assume that differences in Pmax and WTOT recorded between trials performed before and after the break period in training depend on the level of effectiveness of anaerobic glycolytic metabolism in soccer players.

*Bangsbo J., Mizuno M. (1988). Science and Football. EFN Spon, London, 114-124.*

#### P120-08

### Effects of water temperature on heart rate, blood pressure, rectal temperature, and oxygen uptake during water immersion

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**Keywords:** immersion, body fat, rectal temperature

In the water, humans have different physiological responses, compared to land, due to influences of water characteristics such as ascending force, water temperature, pressure and viscosity. Especially, the difference in water temperature is known to significantly affect the maintenance of human homeostasis. These reports assume a close connection between water temperature and energy metabolic rate during water exercise. This indicates that a decreased body temperature is greater for low % fat subjects than for high % fat subjects. Therefore, the purpose of this investigation was to show the effects of water temperature on heart rate, blood pressure, rectal temperature and oxygen uptake during water immersion.

Subjects were eight healthy young men: Age 23.3±2.8 years (mean±SD), height 170.4±4.8cm, weight 64.8±8.1kg, and % fat 17.0±6.2%. Prior to participation in this study, subjects signed an informed consent. Subjects were divided into land (control group) and immersion (experiment group) groups. The land group performed five minute supine position rest on a bed at pool side. The immersion conditions used aqua blocks for neck, ankle and wrist. They got a flowing belt for the lower back and performed thirty five minutes supine position rest in the test tank. Water temperatures were set for three conditions 25, 30, and 35°C. Room temperature was 25.5±1.0°C and humidity was 90.3±4.2%.

In the 25°C water temperature, the serial measures of rectal temperature variation observed differences among individuals. As for the relation of rectal temperature variation, low % body fat subjects significantly decreased, but high % body fat subjects were unchanged. In the 35°C water temperature, the relation of rectal temperature variation in body fat % was observed to be negative. Oxygen uptake significantly increased in 25°C water temperature compared with other conditions. During immersion in 25°C water temperature, 20 to 25 minute and 30 to 35 minute immersion periods showed two patterns: low % body fat subjects

continued to increase, but high % body fat subjects decreased.

The investigation defined that differences in body fat significantly affected rectal temperature at different water temperatures. Differences between water and room temperature, body surface area exposed to air and difference in the body as relates to quality of adipose cells have possible affects on rectal temperature.

#### P120-09

### The influence of light strength training on autonomic nervous system function in young healthy men

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**Keywords:** *autonomic nervous system, baroreflex sensitivity, endurance exercise*

The aim of the study was to assess whether single mild endurance physical exercise causes noticeable changes in autonomic nervous system function in young men.

Seventeen young, healthy men, aged 20 - 24 years, first year students of the Academy of Physical Education and Sport, were included in the study. None of them were practicing any sport regularly during previous 3 months. In the first stage of the study, 10-minute continuous systolic arterial pressure recordings (Finapres, Ohmeda) and heart rate period recordings were performed. In the second stage, a physical exercise test was performed (30 minutes long, 65% of the maximum heart rate). Next, the studied person rested for 60 minutes, then recordings similar to the first stage were performed. From these recordings, several heart rate variability indices (SDNN, RMSSD, pNN50, TP, LF, HF, LF\_nu, LF/HF) and baroreflex sensitivity indices (TF\_BRS and BRS\_peak) were calculated using POLYAN software (Montescano, Italy).

It was found that in the second stage recordings, mean SDNN, TP and TF\_BRS values were significantly higher than in the first stage recordings:  $74 \pm 49$  ms vs.  $91 \pm 53$  ms ( $p = 0,01$ );  $6866 \pm 9793$  ms vs.  $98411 \pm 1196$  ms ( $p = 0,05$ ) and  $9,8 \pm 5,7$  ms vs.  $13,7 \pm 6,5$  ms/mmHg ( $p = 0,049$ ), respectively. Moreover, lowering of the arterial pressure values was found, with marginal statistic significance ( $127 \pm 14$  vs.  $121 \pm 12$  mmHg,  $p = 0,078$ ). The remaining indices were not significantly different in both stages of the study.

A mild physical exercise taken by young men not practicing any sport causes favorable changes in autonomic nervous system in most of the studied persons.

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Convertino VA, Adams WC (1991). *Am J Physiol* 260, R570-575

Cybulska B et al (2000). *Kardiologia Polska* 53, 11-148

Fletcher GF et al (2001). *Circulation*, 104, 1694-1740

#### P120-10

### Frequency dependent pattern recognition of different EMG-activities using wavelets and orthonormal reference functions

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**Keywords:** *EMG, pattern recognition, wavelet analysis*

Electromyographical signals contain the information of different frequencies with different intensities at any point of time of a muscle-activity. Wavelet-analysis is a method to calculate these intensity-patterns by using a defined number of wavelets with different centre frequencies (Von Tscharnner 2002). The purpose of the present study is to show the relationship between the frequency dependent change of EMG patterns and human movements (handball throw) at different quality levels.

EMG (M. flexor and extensor carpi, triceps and biceps brachii, pectoralis major, deltoideus and trapezius) of two subjects altogether five times, at each case ten throws (first subject four times) during a one year study was measured (1000Hz). The quality of throwing was classified by the ball-velocity ranked from worst to best per measuring time. At first frequency dependent intensities of myoelectric signals were calculated by using wavelet techniques (11 wavelets) across the frequency range of 3 to 165Hz. Then the affinities of the intensity-patterns of all trials regarding to trial 45 (best quality) were calculated by using orthonormal reference functions. It is represented by the affinity parameters of begin (first points), intensities (max - min), standardised time courses and over all mean values. At last correlations between the affinity parameters (classified in high and low frequency) and the ball-velocity and the significances of the mean values of all courses were calculated.

Ball-velocity correlates with all affinity parameters of the low and with the course and mean value of all parameters of the high frequency band of the EMG of all muscles. The difference between the high and low frequency affinity parameters of all muscles of M5 (highest quality) and all other measuring points was highly significant (M1/M2/M3/M4 to M5: Sig. < 0.01). Low frequent parameters increase from M1/M2/M3 to M4 (Sig. < 0.01) and the high frequent content of the signals decrease from M3 to M4 (Sig. 0.007) and increase from M1 to M3 (Sig. 0.004).

It can be concluded that the quality of a complex movement depends on the low as well as on the high frequency band of the myoelectric signals. It seems to be that the lower frequency bands which should result from the action of the slower motor units (Wakeling 2001) have a basic function for the investigated human movement. On the other hand the higher frequency bands result from the fast motor units or the difference between the frequency bands could have an important influence on the top performance.

## P120-11

**The dynamic of rectal temperature, hand grip, systemic reaction time and modulation of autonomic nervous system during 24 hours**

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**Keywords:** heart rate variability, autonomic nervous system, circadian rhythm

We studied the circadian rhythms of acrophase on several physiological functions in humans.

Subjects were seven healthy men (24.9±2.0 years old). We measured rectal temperature, hand grip, systemic reaction time and modulation of the autonomic nervous system from the morning (0700) to the next morning (0700). Sleep was allowed for 8 hours from 2300 to 0700. We measured several physiological indexes every two hours between 0700 and 2300 and from 0200 and 0400 during sleep. Blood pressure and rectal temperature were measured after 15 minute rest periods in the supine position. Heart rate variability (HRV) was measured during 5-min periods of controlled frequency breathing (15 breaths/min) in the supine position. Hand grip and systemic reaction time were measured in the standing position. 1. Body temperature rose from the start of measurement. Circadian rhythm in body temperature was at peak during the afternoon. 2. Circadian rhythm in hand grip was at peak around 1600-1800. 3. The phases of the Low Frequency (LF) component (0.04Hz-0.15Hz) and the High Frequency (HF) component (0.15Hz-0.4Hz) in HRV synchronized almost the same. Spectral analysis of cardiovascular signals such as the heart rate R-R interval, systolic and diastolic blood pressure, provides useful indices of short and long-term changes in neural autonomic control. RR is known to reflect beat-to-beat modulation of the sympathetic and parasympathetic cardiac limbs. The RR HF component reflects mostly vagal modulation, whereas the RR LF band seems to depend upon both sympathetic and vagal modulations. However, atropine (0.04mg/Kg) is injected in to the subject while the vein is at rest. The peak of the LF component and the HF component disappeared. Vagal modulation was considered to reflect during rest. For this reason, the HF component was considered dominant at rest. In conclusion, the circadian rhythm of the cardiac autonomic nervous system was synchronized with other physiological indexes of circadian rhythm during controlled breathing.

## P120-12

**Effects of unilateral strength training in spontaneous remission phase after stroke**

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**Keywords:** strength training, stroke, neurology

Previous studies showed positive effects of bilateral and unilateral strength training in stroke patients. The aim of this study was to compare the effects of unilateral strength training beginning within half a year (spontaneous remission phase) after stroke (group 1) and unilateral strength training beginning more than one year after stroke (group 2).

Both training groups underwent dynamic strength training of the paretic leg extensor muscles on the leg press with a low intensity resistance (40-50 % of one repetition maximum (ORM)) on the leg press machine two to three times per week without pathological muscle tone increase. Bilateral and unilateral ORM of the training groups and of a non trained comparable control group were evaluated at the beginning and the end of a 4-week rehabilitation period.

In training groups the bilateral (group 1: from 112±45 kp to 122±45 kp,  $p<0,001$ ; group 2: from 124±40 kp to 138±41 kp,  $p<0,001$ ) and the unilateral ORM (group 1: paretic leg from 46±26 kp to 59±30 kp,  $p<0,001$ , non-paretic leg from 66±30 kp to 72±33 kp,  $p<0,01$ ; group 2: paretic leg from 55±23 kp to 65±26 kp,  $p<0,001$ , non-paretic leg from 71±22 kp to 77±18 kp,  $p<0,01$ ) increased significantly. Unlike group 2, group 1 showed a significantly higher increase in ORM in the paretic leg (34±25 %) over the non-paretic leg (10±16 %) ( $p<0,001$ ). The comparison of the two training groups showed a significantly higher relative increase in extensor strength in the paretic leg in group 1 ( $p<0,05$ ) after the training period. In the control group, no significant change was observed.

Unilateral strength training of paretic side in stroke patients is a useful method for increasing muscle strength in leg extensors bilaterally and unilaterally. The significant difference in ORM increase of the paretic leg versus the non-paretic leg between patients trained in the spontaneous remission phase and patients trained at a later time as well as the significantly higher gain in paretic leg ORM justify early strength training in stroke patients.

## P120-13

**The importance of pulmonary ventilation in H<sup>+</sup> regulation during continuous exercise**

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**Keywords:** respiratory compensation, hydrogen ions, continuous exercise

The aim of the study was to ascertain more detailed [LA], Ve and [H<sup>+</sup>] relationship at acidosis conditions. Therefore, we selected the range of exercise intensity between two phenomenons: maximal lactate steady state (maxLAss) and maximal [H<sup>+</sup>] steady state (maxHss).

Eight males (25±4 years, 74±6 kg, 178±12 cm) participated in a study consisted of one hour continuous exercise on cycle ergometer. The intensity was constant during particular test, but increased from test to test by 20-40 W. The test was repeated several times until time to exhaustion was reduced to 20-30 min. Respiratory parameters Ve, Vo<sub>2</sub> and Vco<sub>2</sub> were continuously measured by using Vmax29c (Sensor Medics USA). Arterialised venous blood was drawn from forearm veins continuously warmed by electrical heater. Blood gas, electrolyte parameters and lactate were measured by using ABL5 and EML105 (Radiometer, Copenhagen) instruments. The time course characteristics of selected parameters were calculated by using combination of different exponential and linear models (Usaj, Kandare, 2001). The characteristics of changes (end values and rate of changes) for particular parameter were calculated for the maxLAss and maxHss intensity. Changes in observed parameters were calculated thereafter by subtraction of values at both exercise intensities (DELTA). Finally correlations were calculated for ascertain relative importance of calculated changes.

The level of maxLAss (262±38 W) showed significantly lower exercise intensity than the level of maxHss (296±33 W). The results showed that [H<sup>+</sup>] decreases at the level of maxLAss instead of [LA] fluctuations at steady level. This was



accompanied by  $\dot{V}_E$  increase. When exercise increased to the level of maxHss, both lactate and  $\dot{V}_E$  rates increased significantly. The increase of the rate of  $\dot{V}_E$  increase showed significant correlation with the range of exercise intensity between maxLAss and maxHss ( $r = 0.93$ ,  $P < 0.01$ ).

The importance of increased rate of pulmonary ventilation seems to increase and to be very important for [H<sup>+</sup>] regulation, when exercise passed maxLAss intensity and metabolic acidosis became more dramatic. The performance of the respiratory system for increasing the pulmonary ventilation seems to be very important for the range of exercise intensity between maxLAss and maxHss where buffering of continuously increased lactate concentration is successful.

Usaj A (2001). *Med and Sci in Sports and Exerc* 33 (5) [Suppl]: S343

#### P120-14

### Effect of oral amino acid and creatine supplementation upon physiological and psychological response

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**Keywords:** supplementation, physiological performance, psychological response

Physiological and psychological response may change after creatine and amino acid supplementation. These changes are usually related to the amount, type and supplementation duration. Creatine (CR), amino acid (AA) and both combined (CR+AA) are frequently advised to enhance sports and fitness performance, however several effects can be observed. The purpose of this paper was to determine the physiologic and psychological perception of change after CR, AA and CR+AA supplementation.

We evaluated PRE and POST 12 weeks, 39 regularly active men ( $2.5 \pm 0.8$  months) that supplemented with CR ( $n=7$ ); AA ( $n=12$ ) and CR+AA ( $n=20$ ). Training program was 4 times/week of weight lifting, with 15 exercises and 94 minutes/session. The applied questionnaire was suggested by VOLEK (1999) that assessed the perception of appetite, thirst, flatulency, joint instability, muscle strength and resistance, body composition, sweating, digestive discomfort, aggressivity, well being, attention and concentration level, well being and sexual activity. Answers were analyzed in: presented decrease (DC), no change (NC) and presented increase (IC) after ergogenics use. Statistical analysis used was the Qui-Square Test ( $p < 0.05$ ).

Data evidenced that after CR + AA use significant increase (IC) was found on: body weight (73.33%); well being perception (46.66%); excessive thirsty (61.23%); muscle strength (86.66%) and power (80.21%). Change on appetite was found ( $p < 0.05$ ) for 56.66% of the group as well digestive discomfort (33.35%). The CR group presented higher values (IC) for flatulency (56.67%); muscle strength (86.43%); well being (79.87%); digestive discomfort (23.49%) and appetite (40%). On the other hand, sexual activity was reported to decrease for 23.11% of SP group, as well as muscle joint instability (13.26%).

Considering the study limitations, data allow us to conclude that different ergogenic aids (CR+AA) and (AA), brought in general, more changes on physiological than psychological variables, what remain inalterable to these same issues. Also it would be interesting to mention that physiological changes are strongly related to weight training what may indicate a

overestimation of ergogenic use, beside positive training effect.

Vollek J et al (1999) *Performance and muscle fiber adaptation to creatine supplementation and heavy resistance training*. MSSE, 31 1147-1156

Huso M et al (2002) *Creatine supplementation influences substrate utilization at rest*. JAP 93, 2018-2022

#### P120-15

### The assessment of a mental status of the young athletes by the analysis of heart rate variability

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**Keywords:** heart rate variability, psychophysiology, mood state

The purpose of the research was to investigate an opportunity to use the analysis of heart rate variability as a marker of the psycho-energetic potential of the young skilled athletes.

A group of 39 young athletes (age 15,7 years; SD = 2,8 years) was investigated. To diagnose the actual psychological status the questionnaire POMS (Profile of Mood States) was used. It allows to determine six parameters of a mental condition: T (tension - anxiety), D (depression - dejection), A (anger - hostility), V (vigour - activity), F (fatigue), C (confusion). As integrated parameter of mental status the psycho-energetic index (ratio of the positive and negative factors of a questionnaire POMS) was used (Bundzen P. et al, 2002). The heart rate monitor (Polar Electro OY) was used to registrate the samples of heart rate. This time series of a RR-intervals was exposed to the spectral (Fourier) analysis (Roecker K., Dickhuth H., 2001). The smoothing was made on five points by a Hamming window. The amplitudes of fluctuations of a heart rate with a step in 0,01 Hz were taken into account. This data was used for the correlation analysis with the parameters of the POMS profile. The results of the correlation analysis have shown that the amplitude of fluctuations of a RR-intervals row on frequency 0,01 Hz is more closely connected with mental status of the young sportsmen. The factors POMS T, F, C and PEN are statistically significant relationship to frequency 0.01 Hz ( $p < 0.01$ ).

In conclusion, the results of the research suggested, that the amplitude of fluctuations of a RR-intervals row on frequency 0,01 Hz may be used as a marker of the psycho-energetic potential of the young skilled athletes.

Bundzen P., Korotkov K., Kolody O. et al. *Teoria i praktika fizicheskoy kultury*, 6, p. 40-44, 2002.

Roecker K., Dickhuth H. 6th Annual congress of the European College of sport science. - Cologne, 2001, p. 52.

#### P120-16

### Validity of repeat suicide drill test in the evaluation of the anaerobic power in elite basketball players

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**Keywords:** basketball, anaerobic power

Repeat Suicide Drill Test (RSDT) is commonly used to evaluate basketball players' anaerobic power performance

(Semenick, 1990). It consists of a 4 trials of 143,25m each, with 4 round trips, 7 changing direction, without stopping. For each athlete, mean result (sum of all trials' time divided by 4) is always considered to estimate his performance quality in this physiological component. Nevertheless, the validity of this test for estimate anaerobic power was seldom or never investigated.

The purpose of this study was to investigate the validity of RSDT in the evaluation of the anaerobic power in basketball players using as criteria method the Two-Speed-Test (TST). In our study, 11 players from Portuguese top basketball teams (1st and 2nd National Leagues) performed the two field-tests in alternate days (48 hours rest between tests) to determine: (a) the maximal concentration of lactate in each test, and (b) the time spent during the execution of both tests. Statistical analysis included only correlations and an estimation of standard error in a regression line.

The results for RSDT revealed an average lactate concentration of  $17.45 \pm 1.9$  mmol/l and an average time of  $29.2 \pm 1.3$  sec. For TST, the results are the following: average lactate concentration was  $12.68 \pm 2.0$  mmol/l; average time spent during the execution was  $43.8 \pm 2.6$  sec. On the other

hand, the results evidenced a low correlation between lactate concentration in TST and the time spent in the execution of RSDT ( $r=0.09$ ,  $p>0.05$ ). The correlation between lactate concentrations in both tests was high ( $r=0.80$ ,  $p<0.05$ ;  $r^2=64\%$ ,  $SEE=1.95$  mmol/l). The highest correlation was established between lactate concentrations in TST and the lactate concentrations evaluated in the first trial of RSDT ( $r=0.84$ ,  $p<0.05$ ;  $r^2=71\%$ ;  $SEE=1.1$  mmol/l).

The results of our investigation evidenced the low concurrent validity of RSDT (results in sec.) relatively to the criteria method, i.e., TST (results in mmol/l), although our sample is very small.

We may conclude, that RSDT (standard formulation) may not be a valid field-test to evaluate the anaerobic power of elite basketball players. On the other hand, it seems practically to use the test as a method to improve anaerobic power performance, and probably not to evaluate (discriminate) athletes in this physiological component.

*Semenick, D (1990). Tests and measurements: the line drill test. NSCA Journal 12: 47-49*

## Poster Session

### Physical Education and Pedagogics 2

P12P

P12P-01

#### The Bologna decree and teacher training of sport science in the Hungarian Republic

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*Keywords: European higher education area, academic degrees, Bologna process*

Two significant dates (1925 and 1948) have played a significant role in the development of training sport experts in Hungary. These two dates can be associated with the development of the dual system of a training system that has been characteristic of Hungarian higher education and training of sport experts within its framework.

When the Bologna Decree was signed by the Hungarian authorities, they assumed responsibility for converting the dual structure of higher education into a linear model until 2010.

The aim of remodelling higher education is to become an equal partner of the participants in the developing Area of European Higher Education, providing a free movement of labour force by means of equal degrees (diplomas) in the European Union.

Remodelling Higher education includes:

- a transparent and comparable system of degrees achievable by a degree supplement,
- a well-graded system of education (undergraduate, graduate and postgraduate) whose first grade (BSC) provides qualifications required by the labour market, the second grade and the third grade provide opportunity of reading for (MSC) and/or (PhD) degrees;
- the introduction of credit system,
- cooperation in quality control in Europe,
- cooperation in fields of research, developing teaching materials, facilitation of teacher--student mobility.

The aim of this lecture is to show how the present dual system of sport experts, on the basis of the above requirements, can be remodelled as a linear model, preserving all the values and traditions providing the

background for the Hungarian sport experts to achieve memorable successes.

P12P-02

#### Education through dance: aerobics as curricular

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*Keywords: curriculum, aerobic dance, trends*

Aerobics became a popular leisure time activity during the last two decades. The aim of this study is to compare the evolution of aerobics in leisure time with the attention of aerobics in the PE curriculum.

The sample consists of 138 PE teachers (59% female) in secondary schools. 42% of the male teachers and 96% of the female teachers are teaching aerobics during their PE lessons. Those who do not, give the lack of their own education as reason.

The results demonstrate that 'high-low' is the most popular approach among female teachers, while their male colleagues prefer to teach 'step aerobics'. For most of the respondents aerobics is an appropriate activity to reach the goals in the category of motor competencies. Concerning the achievability of other goals (physical fitness & healthy life style and self-image & social-functioning) with aerobics, opinions are divided between 'good' and 'sufficient'. 89% of the teachers have different approaches depending on the gender of the pupils. However they do not agree with the statement 'Boys can not dance and therefore are less motivated'. The choice of music is based on the equivalence between the intensity of the movements and the time of the music. The involvement of pupils to select the music is not yet applied. More research is needed to know more about the experiences of pupils themselves with dance in general and with aerobics in particular.

## P12P-03

**Latvia in the Bologna process: the quality of the program of physical education****Shkolnikova Tamara**

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*Keywords: physical education, program quality, Bologna process*

The European process status in Bologna context is based on four moments: 1. Diploma supplement. 2. Bachelor - Master degree system and structure, 3. The promotion of mobility of academic staff and students' by using of ECTS (European Credit Transfer System). 4. Establishment of quality assurance ENQA (European National Quality Association). At the moment, the present degree system in Latvia includes professional bachelor (the first cycle studies) and professional Master (the second cycle). The first cycle, lasting three years, has 180 ECTS. Latvian Master degree study covers two years with 120 ECTS. So five study years cycle includes 300 ECTS. Establishment of a system of credits in Latvia promotes not only students' mobility, but also includes possibilities for lifelong learning. The present research aims to evaluate study programs of physical education in the context of Bologna process (from students' point of view). Data was collected by means of students' evaluation of study courses, self-evaluation, analysing students' answers from different questionnaires. 756 students from four institutions - University of Latvia, Riga Teacher Training and Educational Management Academy, Latvian Academy of Sport Pedagogics and Stradina University of Riga - have been included in this research. They will be prospective lecturers in higher educational institutions, teachers of physical education and biology, sport coaches, sport managers, rehabilitation and public health instructors, specialists of physical education in the kindergarten and others. Research data show that: 1) part of the students aren't satisfied with their study programs - 56,2%, accept studies as a qualitative pedagogical process - 43,7%; 2) the main reasons of this situation are: a) too high requirements for studies - 47,1%; b) lack of intersubjective integration - 45,2%; c) students' overload in studies - too much lessons - 35,2%; 3) it's observed that the biggest part of the students aren't the "strategic", which study only on examination period, but are applying efforts all the time of their studies dynamics to systematic learning - 58,4%; c) students' inquisitiveness - 49,3%; 5) the most part of students need to improve their level of foreign languages - 64,6%.

## P12P-04

**Talent care in Hungary at the doorstep of joining the European Union****Hjduné László Zita, Herlicska Károly, Wilhelm Márta**

University of Pécs, Hungary

*Keywords: athletes, talent care, European Union*

Recognition and care of talent in sports is always an important task. Hungary has accepted the European Charta of Sport that declares that all citizens shall have the opportunity of pursuing sports. Support in sports also includes talent selection and talent care.

The Bozsik junior football player education programme pursues the increase in the number of football players aged 6-18 and a system of the establishment of high level, well controlled, programmes for selection and training.

The Heraklés-programme, in 2001, supported young sportsmen, who partly have been qualified internationally, candidates to the Hungarian National Olympic Team. According to preliminary estimates, 3000 sportsmen can be selected to the A-group of the Talent Care Basic Programme, and about 600 of all the sports to the B-group. This number seems to be realistic, because the recent experiences with the junior athlete programme show that 10-20% of them can be expected to perform well as adults.

The National Athletic Programme (NAP), looks at all sports and shall provide transferability for all the participants, and thus, shall provide opportunity for talent search and talent care in sports, based on athletic capabilities.

National Institute for the Education and Training of junior sportsmen:

- elaborates and evaluates current and newly initiated programmes;
- favours professional orientation, and runs the programme based on the results obtained in the course of assessing the processes of preparation
- Sport schools in the third millenium
- there are two determinations in law, however, almost any school can call itself a sports school - no restrictions and controls are currently built in the system
- Sport clubs in the third millenium
- there are many new clubs;
- the system of leagues has changed
- professional players were contracted from abroad in many ball games

Regarding the traditions, and utilising the opportunities provided by the new system, the endeavours in education and training of the next athlete generation show that these programmes are large scale, provide a firm base of a system supporting sports in the regions. The reform of sport expert education and on training, the specification and development of sports requires a pronounced emphasis in the future.

## P12P-05

**Examination and grading in physical education****Cankar Franc**

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*Keywords: physical education, teacher, primary school, secondary school*

In Slovenia, the system of five numeric grades was abandoned and replaced with the system of three descriptive grades for the so-called upbringing subjects in 1975. With the new legislation, the system of five numeric grades has been re-introduced into the Slovenian schools, with the exception of the lower elementary school grades. There, only a short description of a pupil's development describes the pupil's progress. For the purpose of our study, we have tested such a novelty on a sample group of schools. One of the tasks of our study was to establish the way in which teachers of physical education look on teaching, and examination and grading as its parts.

Our study was carried out on a group of 100 elementary-school teachers, 100 high-school teachers, and 100 technical-school teachers. The collected data were analysed with the factor analysis, discriminate analysis, and analysis of variance.

The first and the most important sub-structure of understanding teaching, examination and grading in physical education, in which the opinions of the teachers reached the highest level of agreement, is defined by the variables that emphasise on function and necessity, respectively, of grading

in physical education. It is obvious that sociological aspects play an important role in the decisions of teachers. The pedagogical aspects are not neglected, but they are rather inferior. A grade obviously helps to overcome and soften some tensions among physical education teachers, who work and live in school, in spite of specificity and difference of physical education in comparison with other subjects. In spite of the fact that teachers regard grading as an important function, the second substructure shows their understanding of teaching very progressively. The teachers consider teaching to be encouragement and help for their pupils in the personal growth process. They focus on the development of a pupil as a whole - movement as well as intellectual and emotional-social aspects. The third sub-structure shows that a smaller part of teachers still consider teaching as shaping pupils according to a certain model. This understanding of teaching considers pupils to be a sort of a "raw material" to be worked on. A teacher in this case is more like a trainer, since training is more important than teaching.

#### P12P-06

### Paradigms of education in Hungarian sport pedagogy

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*Keywords: teacher training, ethical values, subject-object interrelationship*

The system of aims, tasks and methodological procedures elaborated in the theoretical works of pedagogy have always had a significant effect on the pedagogical processes in different fields of education. This effect, in the general and particular systems of interactions, can be interpreted, that sport, in particular, has shown a significant development in the recent decade. The differentiation in the structure of sport pedagogy, at the same time, means a change in the scale of values, which can be the starting point of a pluralistic approach to education in sports. Our aim is to make an attempt to sketch the possible pedagogical background of different fields of sports.

The actuality of this aim is emphasised by the future educational conception ("somatic education"), elaborated by the Hungarian Academy of Sciences, that is a determining component of the conception. Instead of the two-level pyramid model characteristic of the 1950's, today sport can be described as a minimum five-level model. The components of this model, on the one hand, can be regarded as separate; on the other hand, they show similarities. The interrelationship of the components of the model can be described as pairs of activities, e.g., professionalism-amateurism, profit-non-profit views, achievement-health-orientation, open community-subculture groups, etc.

Sport in the life of individuals can be studied in primary and secondary dimensions. Its scenarios are PE in schools, sporting activities in clubs and during leisure time. The secondary dimension, and action-mechanism, at the same time, are present in the media, the economic and political life. This influences, i.e., causes the individual to choose of values, such as deciding how to spend his/her leisure time, what to buy for consumption, what habits to develop, and what causes the individual to make decisions upon local and nationwide affairs. The issues of the second dimension exceed that of the educational processes in a narrow sense, and implicate issues of socialization and interrelations. However, it is assumed that the solid motifs, orientations,

capabilities and competences have a significant role in the decision making upon values concerning the conflicts.

#### P12P-07

### Individual adaptation and perceived readiness during interval training of different volume and intensity in middle-distance runners

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*Keywords: perceived readiness, interval training, adaptation*

Our previous investigations (Karu et al., 2000; Nurmekivi et al. 2001) revealed that LA concentration and its recovery influenced middle-distance runners' perceived readiness estimation to begin a new run. The aim of this study was to investigate whether any groups of individual adaptation exist on the basis of runners' lactate response to exercise and perceived readiness ratings (PRR) in case of different volume and intensity interval training.

Two interval training protocols were investigated. The first investigation was performed on 15 national level middle-distance runners (mean age was 19.6 years, height 181.6 cm, weight 69.8 kg, fat % 7.5. The protocol used, consisted of 4x2000 m runs with stepwise increasing speed on the indoor track (150 m lap) with 5 min intervals between loads. Ten college level middle-distance runners (age 17.3 yrs, height 182.4 cm, weight 66.4 kg, body fat measured by DXA 7.5 %) participated in the second study. A typical set of four 400 m intensive interval runs with individually chosen high speed was conducted on an indoor track. Recovery pauses were of 5 min duration. Capillary blood samples were obtained after runs in the 1st and 5th min of recovery. Ratings of perceived readiness to begin a new running bout were obtained exactly after every minute of recovery using our perceived readiness scale (Karu et al., 2000). The scale had anchors of 1: not at all ready to begin and 5: completely ready to begin.

The results indicated that higher LA concentration after intensive interval running of 4x400 m caused a smaller perceived readiness ratings compared with interval running 4x2000 m with increasing speed. The most interesting finding of the study was that it is possible to distinguish between three athlete groups on the basis of their lactate response to exercise and its perception. In both interval running variants in groups A and C are runners whose perceived readiness scores were adequate. In Groups B are the most problematic runners having high LA levels with their low perception.

We suppose that those athletes have higher danger for overtraining, because they perceive high acidosis as low.

Karu T. et al. (2000). *Scand.J Med Sci Sports* 10:33-36

Nurmekivi A et al. (2001). *Perceptual and Motor Skills* 93: 397-404

#### P12P-08

### The position of leisure-time sports in the scale of values of students of different ages

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*Keywords: scale of values, time balance assessment*

The choice of leisure-time sporting activities, their content and frequency are determined by the amount of free time, the

situation of the sport institute and its facilities. The amount of free time and the facilities are known to belong to objective conditions. Knowledge of sports, interests in different sports, and the system of incentives, etc. are known to belong to subjective conditions.

Nowadays, spending the available amount of free time intelligently is said to belong to social tasks. Individuals should be prepared for how to spend their free time intelligently.

A significant role is attributed to regular physical education and sports in executing this task.

The aim of this study is:

-- to investigate the position of sporting activities in the overall system of activities in case of primary and secondary school pupils and university students;

-- to investigate the incentives of choosing certain sports, and the system of incentives;

-- to find out whether there are changes in the preferences in the process of aging.

To reveal the patterns of the structures of activities we have performed a time-balanced assessment in the course of our investigation. A five-grade Lickert type questionnaire was used for measuring the incentives of preferences and the position of leisure-time sports in the scale of values.

In our opinion, the attitude towards leisure-time sports is influenced by PE teachers, coaches, parents and successful sportsmen.

We cannot afford to be indifferent to whether sport experts are well trained professionally and pedagogically to do their jobs effectively; whether they introduce their students to positive values of leisure-time sports and provide their students with opportunities to develop a positive attitude.

In our opinion, the documents of certain types of schools include the requirements of developing regular PE and sporting activities, however, these documents do not provide opportunity of choosing preferences. On the basis of our investigations, we wish to propose recommendations related to certain types of schools.

## P12P-09

### Searching for young talents in sport

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*Keywords: early identification, young children, talent selection*

The training of young talents requires a well developed social environment which means a high level of social organization. The early specialization remains the most important factor in sports because of the high psycho-motor coordination demands. Therefore, the talent for sport should be identified in early childhood.

Outstandingly talented children represent only 3 percent of the entire population (out of 16.000 entities in Slovenia).

Therefore, a systematical search for young talents requires a complex system of standards and percentile norms, which means testing of a great number of entities. For this reason, 1500 children of both genders (aged 5, 5 ½, 6 and 6 ½) have been tested by 28 motor tasks and 32 anthropometric tests at Maribor University during twelve years recently. Besides, if we want to describe a child as a young talent, we have to define his/her capacity to learn motor information quickly and effectively by means of pedagogical experiment with parallel groups. Within the last three-year testing, 60 groups (6 children aged from 5, 5 ½, 6 and 6 ½ in each one) have been tested.

The standards of 28 motor tasks and 32 anthropometric characteristics have been reckoned, however only 10 to 20 motor tasks and 2 anthropometric tests are used in daily practice (Rajtmajer 1997). Similar tests have been carried out in sporting kindergartens in Germany (Zimmer 1983). Research projects mentioned above are aiming at assuring a stimulative social sporting environment where young talents can develop motor abilities and get a wide motor knowledge by means of systematical several-year training. Finally, testing and classification are carried out by means of percentile norms (results classified in 15 groups). In that way, the criteria used to evaluate the real psycho-motor status of a child are defined.

*Bös & Mechling (1983). Dimens Sportmot Leist, Bd 17*

*Rajtmajer, D. (1997). Diagnostic-prognostic Value of Norms of Some Motor Abilities of Younger Children*

*Zimmer & Volkamer (1984). Motoriktest fuer Sechsjährige*

## P12P-10

### Cardiovascular disease risk in male and female physical education teachers

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*Keywords: physical education, cardiovascular risk, teacher*

The study was performed with aim to evaluate the level of habitual physical activity of Croatian PE teachers and to determine their cardiovascular (CV) disease risk.

The subjects filled in the physical activity questionnaire as well as the 8 item CV risk questionnaire. Only the subjects that answered all questions were taken into data evaluation (124 men, age 42.2±9.0 and 69 women; age 40.3±8.8; p=0.141).

First, the overall risk (total score) was calculated. The mean risk in male group was 19.39±4.46 points and 14.18±2.94 points in female group (p<0.001). The significantly higher risk in male group was understandable, even though the values were higher than expected, because 18-24 points were average population risk. The mean overall risk for female subjects was much lower than expected in normal population. In order to explain the much lower risk in female group compared to the average population and the lack of difference between male PE teachers we analysed the differences in smoking, physical activity in leisure time, systolic pressure, cholesterol and body mass between the groups. Even though men spent significantly more hours per week in sports activities (4.74±0.65 vs. 3.44±0.60; p=0.001), the female PE teachers were much more active in their leisure time, spent less hours in front of TV and in the car. There were no significant differences in smoking habit (18% of men and 21% of women smoked) and cholesterol levels. The values of systolic pressure and the obesity indicator were significantly higher in men, which was probably the reason that the overall risk score was quite high. In men, 39% of the subjects had systolic pressure of 140 mmHg or above, while only 9% of women were in that range (p<0.001). Male PE teachers did not have lower risk for development of cardiovascular diseases in comparison to the average population. Their counterparts, the female PE teachers had much lower risk than the average female population, which could be contributed to the higher level of habitual physical activity, better weight control management and lower systolic pressure. Even though male PE teachers were physically active at job, they still kept the sedentary habits and were slightly overweight, which minimised the positive effects of their physically demanding workplace.

## P12P-11

**Changes in teacher's role and the effects on sport expert education and training**

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*Keywords: teacher's role, way of life, mobility of roles*

Since the 90's social changes have accelerated and development has become intensified in Hungary. The base for a new society of teachers with a new attitude and education is needed that provides facilities of education, capabilities for appropriate working conditions and levels corresponding to its significance. Teachers are needed who, due to the new tasks, conditions and possibilities, are capable of complying with the new requirements.

The goal of creating new values is the establishment of a base for a constructive way of life that is valuable socially, and successful individually. Teachers are supposed to have a regulatory function in this process whose action-mechanism is separated into two, on the one hand, into a selective, on the other hand, into an orienting branch. The main task is to organise activities in which the students are affected indirectly, in an autonomous way, by natural practices, motivated internally and develop their own personality. All this requires changes in the complex roles of teachers. A presently stable and independent profession has become more open, requiring self improvement in the profession.

PE teachers are expected to comply with these processes, since they are to achieve the same aims through their subject. This is important because they are expected to execute their tasks, following rules and patterns, employing their original ideas and inventiveness in order to earn social respect both in schools and society.

The new task integrated in the role of PE teachers require highly educated and well trained teachers with practical experiences, where the professional skills are supplemented by functional capabilities. PE teachers are expected, first of all, to acquire skills at cooperation and organisation due to the mobility of their roles.

An assessment has been carried out by means of questionnaires, individual and group interviews, in order to gather data concerning PE teachers' opinion on kinds of components and sequence, that played roles in their education and training; i.e., to which extend the teacher training institute has participated in this process. Information has been gathered about shortages in education and training that have been observed.

On the basis of the obtained results, we have established some areas of tasks, which, in our opinion, should be present and incorporated in the context of the training programme of sport experts.

## P12P-12

**The effect of fair play approach on the behaviour of sportsmen**

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Fogarasi Gabriella**

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*Keywords: attitude assessment, orientation motivation, fairness*

Nowadays, all the scenarios of socio-economic life are characterised by competition: competition at the world

market, competition in developing the levels of technology, competition in space technology, etc.

It is not a trouble that our life develops in different fields of competition, since competition accelerates development. Certain complications occur when certain countries employ immoral means to achieve their aims in their own interests, violate the interests of other countries both socially and economically.

The tensions and contradictions occurring in economic life get transferred to other walks of life, such as culture and sport. Aggressive behaviour of fans in a stadium occurs more and more frequently. Sportsmen often forget about sportsmanlike behaviour and norms of ethics in the course of training, and even at sport events in order to achieve better and better results. Coaches and teachers often forget to include the rules of "fair play" in their personality development programmes. Teachers and coaches cannot afford to be indifferent to ethics and value-orientation related to sport in case of school-aged people. These values should be considered to be significant in sport activities. It is important to note that "fair play" should be a pedagogical extra in our educational programmes that are used in our work.

The aim of this study is to assess how far young people in different age-groups are informed about ethics related to sport activities and games and to reveal the value-oriented forms of behaviour that influence the development of personality.

In our opinion, the ethical, value-oriented forms of behaviour play a determining role in developing patterns of behaviour in sportsmen.

We have performed an assessment by questionnaires related to sportsmanlike behaviour, and we have made the Lickert kind of five-graded scale to study the value-components of, and value-orientation to "fair play".

On the basis of the results of these studies, recommendations have been made concerning the possibilities of developing value-orientation, and the tasks related to this issue in training experts in sport.

*Földesiné SG (1994). Hungarian Olympic athletes about themselves and sport*

*Papp G (2002). Sportsmanship as an ethical value*

*Radák Z (1993). Sportsmen, sportmoral*

## P12P-13

**Physical training and adaptation at the specific effort at juniors III level (basketball)**

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*Keywords: non-specific training, adaptation, motor qualities*

Physical training is an important component of the sportive practice especially at the minibasketball, children and junior's level. In Romania, the coaches used only classic means to develop the level of motoric qualities implied to increase the adaptation of body at the specific effort.

The hypothesis was: if the coaches use at basketball juniors III level specific and, especially, nonspecific (athletics, gymnastics, swimming, table tennis, field tennis, volleyball, football) physical preparation, the level of somatic, motoric and psychomotoric indicators will record a significant progress and the adaptation at the specific effort will be better. We reproduce here the results obtained with a Ruffiers' test with all values and interpretations (initial, intermediary, final tests). The data was collected from 39 players (e.g.) and 42 players (c.g.) from Sportive School Craiova and the training began in April 2000 and finished in June 2002.

Mathematical averages: initial test(e.g.-8,66, c.g.-9,04), intermediary test (e.g.-6,18, c.g.-6,08), final test(e.g.-3,68, c.g.-5,07).

Through "t-Student" we verified the null hypothesis: the difference between progress obtained by those 2 groups, concerning adaptation at the specific effort, after 1, 2 or both years of preparation haven't like cause the new methodology proposed and applied by authors. After 1 year a value of  $p=0.1357>0.05$  was obtained which means that our hypothesis was confirmed and the progress between those groups is insignificant. After 2 years of preparation, a value of  $p=0.0023<0.05$  was obtained, which means that our hypothesis was infirmed and the progress between those groups is high-significant. The new methodology of training, a physical preparation with a content given by specific and, especially, nonspecific preparation is a valid proposal for all coaches and can be the only chance to obtain the maximal efficiency in physical preparation with positive transfer to adaptation at specific effort.

L. Antoniale, A., Antoniale, *The development of the skill efficiency in training and game courses for the representative team, 4th Annual Congress of the European College of Sport Science, Rome, Italy, 1999*

A. Dragnea, *Theory of training, EDP, Bucharest, 2002*

#### P12P-14

### Perceptions of teacher's feedback and threat to sense of self in physical education: A structural equation modeling in a longitudinal perspective

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*Keywords: physical education, teacher's activities, self-esteem*

Perceptions of threat to sense of self have shown to be important predictor of intrinsic motivation (Mitchell, 1996). Studies have demonstrated that perceptions of coach's and

general positive feedback resulted in increased perceptions of competence and corresponding increase in motivation (Amorose & Horn, 2000; Koka & Hein, in press). In this study it was hypothesized that students' perceptions of teacher's feedback may have an effect on threat to sense of self. The purpose of the study was to investigate the changes in perceptions of the teacher's feedback and threat to sense of self over the two-year period.

The participants were 294 students aged 12-17 years. Students' perceptions of threat to sense of self (THS) was assessed by the subscale presented by Mitchell (1996). Perceptions of teacher's feedback with dimensions of positive specific feedback (FI), positive general feedback (FII), and knowledge of performance (FIII) were assessed by PTF (Perceived Teacher's Feedback; Koka & Hein, in press). Students were administered questionnaires on two occasions over the two-year period (Time 1 and 2). A structural equation modeling procedures were executed using LISREL 8.51.

The results of the both structural models were similar. Perceptions of THS was significantly predicted by FII and FI. The measurement error of variance was .73 for the Time 1 model and .78 for the Time 2 model. Thus, two types of perceptions of teacher's feedback accounted for 27% and 23% of the variance in perceptions of threat to sense of self, respectively.

The results indicated that structural models and goodness of fit statistics didn't differ statistically from each other over the two-year period. It indicates that students' perceptions of teacher's feedback and threat to sense of self remains continuously the same. PE teachers should consider the fact that positive general and positive specific feedback are the strongest predictors of threat to sense of self. Hence, more positive general feedback mixed with specific feedback, the more non-threatening learning environment is perceived by students.

Amorose AJ, Horn TS (2000). *J Sport Exerc Psychol* 22: 63-84

Koka A, Hein V (in press). *Psychol Sport Exerc*

Mitchell SA (1996). *J Teach Phys Educ* 15: 369-383

## Poster Session

### Physical Education and Pedagogics 3

#### P12Q

#### P12Q-01

### Changes in pupils' attitude towards fairness induced by moral education

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*Keywords: physical education, attitude, fairness*

Research points to the importance of Physical Education (PE) incorporating issues relating to fairness and fair play. However, until now no empirically validated research as to the effects of fairness education on pupils' attitudes towards fairness has been reported. The aim of the study was therefore to compare the effectiveness of direct (ex-plicit) fairness education with incidental (implicit) learning of fairness during PE lessons. The results presented in this paper focus on changes in the pupils' attitude towards fairness after a six week teaching unit.

A six-week longitudinal study was conducted with two seventh grade classes (age-range 12-13) consisting of 24 and 25 pupils respectively. In one class, the learning process was deliberately directed at improving pupils' fairness

awareness (fairness education class, FEC), in the other class fairness was not explicitly discussed as a topic (physical education class, PEC). At the beginning and the end of the study, participating pupils filled in a questionnaire on their fairness attitude consisting of 32 fairness-related items comprising statements relating to seven categories.

At the beginning of the teaching unit, there were noticeable differences between the two classes regarding their attitude towards fairness in some of the variables. After six weeks, fairness attitudes improved significantly in all categories in FEC. In PEC a slight improvement was registered only in one category; in two categories however the attitude towards fairness deteriorated markedly. Consequently, a two-tailed ANOVA with repeated measures shows significant to highly significant F-values for the influence of the teaching unit.

Results indicate that pupils' attitudes towards fairness can be very much improved through direct fairness education, whereas incidental learning of fairness in PE does not seem to lead to an improvement in pupils' attitude towards fairness. The results therefore lend support to the notion that PE lessons can benefit from explicit fairness education.

P12Q-02

**Motor activity in school integration framework**

**De Anna Lucia, Sabatini Alessandro, Catania Claudia, Franco Stefania, Lanciotti Rosita, Mastroandrea Celina, Tordi Ornella, Villanella Gaetanina, Sánchez Utgé Marta**

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*Keywords: motor activity*

The present school model in Italy comprises, in Secondary Schools (first degree), two hours a week of physical education to whom we add sport competitions, mainly during the school morning hours.

The formation offer is enriched through sport activities in the afternoon hours (football, volleyball, swimming...), sometimes with agonistic character.

With regard to the research carried out by the School of Specialization in Secondary Teaching of the Lazio Universities, we have realized an analysis aimed to define an outline of Integration accomplished in Italian Secondary Schools (first degree).

The research has been carried out through a survey form divided into 5 topics, filled out during the interviews addressed to the specialized staff employed in schools.

The results indicate that 70% of the sample schools are located in areas far from down town Rome. The social and cultural level of the students is middle/high, with a multiethnic presence of 70%. The organizing outline of Integration includes: technical groups (44%), "funzioni obiettivo" (chosen teachers, responsible for educational/management areas of the Formation Offer Plan of each school: 27%), departments (18%) and other types of organization (18%); the didactic outline includes classes and laboratories (multimedial 31,3%, arts 31,3%, theatre 18,8%, psychomotor, music and gardening 6,3%).

The results indicate that the presence of psychomotor laboratories is sub-standard compared to the other activities of the schools' educational offer. The data is even more evident if we consider that all the sample schools belong to compulsory education age and have many students with severe disabilities who would take advantage of finalized motor activity added to the common one practised with the classmates. In addition, we have to remind that this situation is present in all the realities examined.

P12Q-03

**Currency and popularity of football for young ladies of 10-18 years**

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University of Pécs, Hungary

*Keywords: football, attitude*

Women's football has become popular all over the world. One of the evidences of its popularity was provided by the Olympic Games of 1996 where women's football became an Olympic event. FIFA supports this, relying on women football players bringing up their children to pursue this sport, increasing the fresh supply both in men and women in, this way.

The aim of this study is to find the main factors that influence the development of this sport positively and/or negatively. In this way, we would like to emphasize the fact that experts should consider these factors, and incorporate them in their programmes.

How does the distribution of ambitious young ladies take place? How far do the subjects studied know this sport, the structure of championship and the teams?

Do they know the members of the national team, and their results? What attitude do parents and teachers have toward this sport? What is the distribution of football-playing girls in the counties?

Our hypotheses are that, in the counties where a women's team plays in the First National League, this sport is known better than in the ones where there is no women's team at all. In these regions, the training is more effective, and there are more young ladies with such ambitions.

Sampling: We have performed an assessment of a group of 435 girls of 10-18 by means of questionnaire, in seven counties, in Hungary (Csongrád, Fejér, Győr-Sopron-Moson, Pest, Tolna Vas and Zala Counties).

On the basis of the results of our assessment, it was found that the following concrete tasks should be carried out in order to promote this sport: 1. A sport base should be established for selecting talented young ladies. 2. A change in teacher and parent attitude is needed. 3. The quality of sport expert training should be improved. 4. Training lady teachers should be emphasised in the PE teacher training. 5. Players should be provided with appropriate facilities such as sport fields, locker-rooms and equipment, etc. 6. The participation of media should be emphasised in case of live broadcast and commercials. We cannot like what we do not know!

Solving these problems should not be delayed, because women's football has been developing rapidly.

P12Q-04

**Research in the attitude of persons active and inactive in sports towards sexual stereotypes in life and sports, analysis of the Lithuanian case**

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*Keywords: sexual stereotypes, sexual roles, social environment*

The relevance of work is caused by abundance of articles and research in foreign literature on the problems of distribution of sexual roles and stereotype formation, whereas in Lithuania this topic has not been researched and analysed in detail so far. There is a lack of research, which would attempt to determine the attitude of persons active in sports towards sexual stereotypes. When analysing the attitude of persons, it is important to perceive the origin of sexual inequality and to understand which sexual differences are real and which are the outcome of stereotypes that have been formed in cultural process. During last 40 years the abundance of research has been carried out in order to find out the image of a typical woman and a typical man, and it was determined that 75% of respondents' opinions on the characteristics of opposite sex coincide (Forisha, 1978; Meth, Pasick, 1990; Scanzoni, Scanzoni, 1988).

Analysis of literary sources, method of analytic induction (when making conclusions), questionnaire (when examining the attitude of persons active and inactive in sports). The questionnaire consisted of 3 blocks (attitude, emotions and behaviour) with 6 stereotypes in life and sports in each.

In order to examine, determine and compare the attitude of persons active and inactive in sports towards stereotypes in sports and life, we investigated 50 men and 50 women active in sports, and also 50 men, and 50 men and women inactive in sports, all from 18 to 50 years old. 80% of men active in



sports and 78% of women active in sports think that there are no men's and women's branches of sport. 90% of men inactive in sports and 84% of women inactive in sports think that there are men's and women's branches of sport. 88% of all respondents who took part in the questionnaire think that sexual stereotypes exist in Lithuania.

Most part of those who are active in sports think that there are no men's and women's branches of sport (stereotypes in sports do are non-existent). Most part of those who are inactive in sports thinks that there are men's and women's branches of sport. Most of all respondents who took part in the questionnaire think (independently from sex and cultivated branch of sports) that sexual stereotypes exist in Lithuania.

#### P12Q-05

### PE curricula in 2003 in Hungary

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*Keywords: physical education, curriculum, pedagogics*

In September 2003, a new age will begin in the nearly 200 hundred-year-old history of state controlled education and in the history of curricula of same age. We are to page the centralised, dictating version of curricula of 1978 last time. Its gradual cessation and termination have been initiated by the documents of decentralised management of education (1998), i.e., National Basic Curricula, and the Framework Curricula of 2000.

PE as a subject in the system of school education has an outstanding position in youth education in general. To be capable of executing their tasks, the highly educated and well trained PE teachers need appropriate centrally and locally elaborated curricula to set the bases of achieving educational values. Local curriculum is a novel no-tion.

Local planning is a new and unusual task for the Hungarian teachers. These changes justify the investigation of the curricula as a document pedagogical management of education. This investigation provides information, first of all, for shaping the pedagogical practice playing a significant role in teacher training.

The aim and task of this investigation is to reveal the most significant data and interrelations related to the plans used for training the would-be PE teachers to preserve our PE values in the course of managing and executing teaching practice in a new spirit.

To achieve our aims the following issues were raised:

What are the outgoing curricula like?

Do these curricula have values that should be preserved?

Which negative properties might have set root as a consequence of its having been used for a long period of time, which are unwanted for the future curricula?

Which are the most significant tasks resulting from the Framework Curricula, the two-level management of education?

Do the new curricula provide appropriate professional and pedagogical guidelines for planning?

The analysis of the current centralised and decentralised documents of the management of education.

The presentation, analysis, and comparison of curricula from the point of view of curricula theory, the theory of sport pedagogy and subject pedagogy in form of short texts, mainly by means of tables.

We answer the questions raised above, and sketch the information to be utilised in the course of education. The recommendations related to the local planning can be described in the following two topics: Presentation of the

values of the PE subject at levels of local planning. A system of views for elaborating educational programmes reflecting the particularities of the schools.

#### P12Q-06

### Defining motor skill set types on the basis of two test systems

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*Keywords: testing, typology*

In the last few years I have studied a possible approach to categorize motor skill sets. The results produced by the research so far show that there is a spontaneous structural differentiation where the test subjects have outstanding conditioning capabilities. Sex and age does not appear to influence the results. The significant and evident performance differences stemming from sex and age have no impact on these typical differences. Several samples and different test combinations produced the same results. In summary, 40% to 50% of the test subjects fall in the "normal/average", 15% to 20% in the "high endurance", 15% to 20% in the "strong", 8% to 12% in the "explosive" and approximately 5% in the "fast" category, and each group is characterized by a distinct set of motor skills.

The poster summarizes these differentiation characteristics on the basis of data produced during the testing of the Center for Education Testing in Szeged, Hungary.

The test was conducted during May 2000, involving sixth, eighth and tenth graders (N=5997). At this point, the data that has already been processed is limited to the Arday-Farmosi and Hungarofit tests. This is the first time that I have used these tests for motor skill set categorization. Both tests produced similar results.

Outstanding performances (P80%) produced in the tests, disaggregated by sex and age group, were categorized into subgroups, and then these subgroups were compared to average, "normal" performances. A discriminant analysis of the select groups produced significant results in all possible variants. On the basis of the test data, the discriminative model has an approximately 90% reliability in classifying performances in the correct group. The differences are also markedly visible in the test item averages of the groups, allowing easy illustration with dimensionless standardized values. The star diagrams also reflect the motor skill structures characterizing each "type".

The results of these tests correspond to other motor skill set typology results produced by other tests. Motor skill set typology based on dominant individual movement characteristics appears feasible when using simple sports motor movement tests with a high number of subjects and adequate data processing capabilities. When differentiation and motor skill type categorization is done on an in-depth basis, it can have an impact on the entire spectrum of physical education and sports training, particularly on the issue of workloads.

P12Q-07

### Training and sports competitions versus physical efficiency and social maturity of people mentally retarded to a moderate and considerable degree

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*Keywords: mentally retarded, physical efficiency, social maturity*

Sport practised in the society of mentally retarded people can be conceived as an activity targeting at developing physical efficiency impaired due to different reasons. This experiment aimed mainly at showing dependencies between training and participation in sports competitions, and physical efficiency and social maturity of the subjects mentally retarded to a moderate and considerable degree.

The research involved a selected group of young people with IQ 30 - 50 points, attending special schools. There was employed a questionnaire, elaborated by the author of this experiment, and Gunzburg's test assessing the level of social maturity of mentally retarded people in four basic categories: basic activities of daily living (BADL), communication, and social and physical functions. In order to assess the level of physical efficiency, there was employed Eurofit Special Test adjusted to the mentally impaired. Physical efficiency tests were carried out in the following order: standing broad jump test (SBJ), sit ups test in long lying position (SUP), bending forward, 10 metre run, medical ball throw for distance and walking on a gym bench.

In order to establish dependence between participation in training and competitions, and their impact on physical efficiency and social competence of people mentally retarded to a moderate and considerable degree, the subjects were divided into three groups: actively engaged in sport. i.e. the ones taking part in training and competitions at least at the level of a province, not actively engaged in sport, and the ones who take part in competitions only during the days of sport in their own schools.

The results achieved explicitly convince us that training and participation in sports competitions positively affect improvement of physical efficiency of people mentally retarded to a moderate and considerable degree. Based on the results achieved, we can conclude that despite the fact that the subjects performed training targeting at physical efficiency and participation in sports competitions - not the one concerning social function, communication and basic or physical activities - this sports training considerably affected the advancement of social maturity level of the subjects.

P12Q-08

### Comparison of fatigue complaints between work in the morning and physical exercise, Judo, in the afternoon in students

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*Keywords: fatigue, judo, clinical work*

A fatigue survey was conducted on the students who worked at a reduction clinic in the morning and attended a daytime paramedical school in the afternoon by using a questionnaire on subjective symptoms.

The school was open during 1:30-4:30 p.m. Fatigue complaints before and after working and Judo training at school were examined. Subjects were 23 healthy students

aged 19-26 years old. The subjects had to fill in the questionnaire five times a day, i.e., before and after working, before and after school, and before sleeping. Analysis of fatigue complaints was performed on 10 items out of the total 30 items as follows: 1) dull headache; 2) weariness in the body; 3) weariness in the legs; 4) yawning; 5) absentmindedness; 6) sleepiness; 7) tired eyes; 22) stiff shoulders; 23) lumbago; and 25) thirst. The presence and absence of complaint for each item were represented by o and x, respectively. The transition rates from x to o and from o to x were shown as Pxo and Pox, respectively. The effects of working and Judo training on fatigue were examined by comparing Pox and Pxo values.

The total number of the complaints regarding the total 30 items at the five time points from early morning to night were 154, 96, 131, 175 and 192, showing an increasing tendency along with time. The total number of complaints regarding the selected 10 items was 103 before working and then decreased to 56 (43.6% decrease) after working. This decrease was almost equal to that examined for the total items. The effects of working and the Judo class on subjects' fatigue were evaluated by the difference in the transition rates (Pox-Pxo). The Pox-Pxo values associated with working were fairly high: 61.7% for yawning, 64.6% for absentmindedness, 52.2% for sleepiness and 43.4% for tired eyes. The Pox-Pxo values associated with the Judo class were 38.1% for yawning, 17.6% for absentmindedness, 14.4% for sleepiness and 19.9% for tired eyes. The degree of tension was 62% during working and 27% during the Judo class, showing a marked decrease. This result suggests that during work the subjects were exposed to about twice as much stress than in comparison with Judo training.

P12Q-09

### Physical education teachers' attitudes towards using physical education portfolio (PEP) in Hong Kong

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*Keywords: physical education, portfolio, teachers' attitudes*

The application of an observation checklist, portfolio cards, has the function of providing feedback, as well as providing a record for students' performance. With regard to PE assessment, the educational reform in Hong Kong is inclined to adopt Physical Education portfolio (PEP) to support the accountability of PE teaching (HKCDC 2002). The concept of PEP is new for Hong Kong PE teachers. The aim of this study is to evaluate PE teachers' attitudes towards using PEP in Hong Kong.

The sample group included 150 PE teachers (54.5% and 45.5% were secondary and primary school PE teachers respectively) who attended a conference titled "Teaching and Learning in Physical Education: Learning Portfolio" on 29th June 2002. The teachers were asked to complete a questionnaire, which was developed from the pilot research (Chan, Carroll and Hong, 2002). This study found that most of the PE teachers agreed with the seven main benefits of the PEP (mean = 3.13, SD = 0.38) (each scored on a 4-point scale from 1 to 4, 4 represents strongly agree). They would be willing to try to use PEP (mean = 3.22, SD = 0.53) and the Record of Achievement Form (mean = 3.176, SD = 0.54) if there is enough support. The PE teachers believed that students' parents would be willing to share students' learning of both the academic subjects and PE. However, there are significant differences ( $t=4.05$ ,  $p<0.01$ ) between these two perceptions; more teachers thought that parents were willing

to share their children's academic learning than PE learning. With regard to the time schedule of the PE course, over 75% of the teachers responded that the amount of time given to PE currently was limited.

The finding showed that PE teachers agreed to the benefits of PEP, however, they considered that when compared with the academic subjects, parent would have low interest towards students' learning in the PE subject. Moreover, the limited time was also another main factor, which influenced PE teachers' motivation in using PEP in the PE course. The "reality of the implementation" is the main factor with which teachers are concerned (Marsh, 1992). It is therefore necessary to find effective methods related to the implementation of PEP, otherwise "teacher barriers" may hinder the new curriculum change, thus a process of action research is suggested.

Chan WK et al (2002). 44th ICHPERoSD World Congress.

HKCDC (2002). The Curriculum Development Council.

Marsh CJ (1992). London: Falmer Press.

#### P12Q-10

### **The importance of age appropriate motor skills in successful school performance: A longitudinal comparative study of preschool and first grade children**

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*Keywords: psychomotor skills, preschool children*

The study aimed to compare the aptitudes of preschool children coming from different preschools through the course of two years until first grade, and drew a baseline of psychomotor skills in relation to school maturity on the following parameters: attention, memory, static and dynamic balance, fine and gross motor coordination, eye-hand coordination, and copying patterns. The main objective of the study was to reinforce the importance of age appropriate motor skills in the successful school performance, and such to emphasize the value of movement as a tool enhancing learning.

In the study 286 children (age 5-7 years) from 12 preschools of Szombathely participated. The attention was assessed by the Csanadi-test. Verbal memory was evaluated by repeating a four sentence story, and the visual memory was assessed by a successful evocation of a 7 picture table. Static balance was evaluated by standing on one foot, and the dynamic balance was evaluated by walking on a gymnastics bench. Fine motor coordination was assessed by ability to string 10 beads onto a stick. Long jump from standing and skipping on two feet in place measured gross motor coordination. Eye-hand coordination was measured by throwing a small ball into a gymnastic stool. Movement copying was assessed by a reproduction of a 4-cadence gymnastic exercise. In the statistical analysis Vargha (1999) Ministat program was used incorporating basic statistical test (mean, Sd, Z-value), O'Brien-test, Levene-test, and tests of linear and partial correlation.

Good visual memory predicted the completion of the attention test with the least error. Our results reinforced the positive correlation between static and dynamic balance. Interesting relationship was found between dynamic balance and attention time. Positive correlation was found between the tasks of fine motor coordination and gross motor coordination. The latter task also showed positive relation to verbal memory. Verbal memory had surprisingly wide relationships with the other variables.

Coordinated movement executions presume disciplined thinking, which in turn reinforces that age appropriate motor skills enhance learning.

#### P12Q-11

### **A preliminary study on the development of self-efficacy towards the performance of physical abilities for Hong Kong secondary school students (aged 12-17)**

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*Keywords: physical education, self-efficacy, teaching*

Feltz and Weiss (1982) suggested that the teacher could enhance students' self-efficacy by ensuring performance success, as well as reducing anxiety-producing factors. The purpose of this study was to examine self-efficacy toward the performance of physical abilities for Hong Kong secondary school students from levels one to four, including both girls and boys from twelve to seventeen years of age.

The subjects (N = 762) in five different schools, fulfilling the above criteria, completed a self-efficacy test questionnaire. The subject group included 140 athletic students and 622 non-athletic students in the same academic years. This research adopted and modified Gramham's (1991) questionnaire of Test of Self-Efficacy. Students were asked to evaluate their perceived ability in performing a set of fourteen specific tasks that were related to participation in a range of physical activities. For each question, student subjects were asked to select from a range of three responses, namely; a) I have the ability to perform the task (score 3); b) I am not sure (score 2); or, c) I don't have the ability to perform the task (score 1).

This project used the split-half method to measure the reliability of the questionnaire and the project found that the reliability of the questionnaire is 0.74. The mean score of Hong Kong secondary school students, on the perception of their ability to perform various physical activities, was 2.14 (S.D. = 0.32). With regard to the sum mean for all 14 questions, there were significant differences between the males and females ( $t = 5.58, P < 0.001$ ), as well as between the athletic (sports team participants) and non-athletic (non-sports team participant) groups (male:  $t = 6.67, P < 0.001$ ; female:  $t = 6.67, P < 0.001$ ). One-Way ANOVA was adopted to analyze the difference among levels. This project found that there are no significant differences between males from different levels ( $F = 1.439; P > 0.05$ ) but there are significant differences between females from different levels ( $F = 6.095; P < 0.001$ ).

This study found that the development of students' self-efficacy toward the performance of physical activities was not significant among the four different secondary levels. However, the findings demonstrate that sports team participation was effective, to a significant level, in enhancing students' perception of self-efficacy in the performance in a range of physical activities, especially for the female students.

## P12Q-12

**The new academy: requirements for success versus the holistic human****Freeman William**

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*Keywords: physical education, curriculum, history*

Over the last several decades, physical education has developed a more scholarly focus described by terms such as "sport science". This was a shift in focus from teaching applied methods to developing the scholarly knowledge that would support the field in a university setting. The question is whether the "academically successful" (or, professionally rewarded) research approaches have become so narrow that the field no longer helps people - or even produces potentially useful information. Has kinesiology/exercise science abandoned physical education and sport as its focal field?

In 1964 Franklin Henry called for more research and a scientific focus. An examination of the past 40 years in the field shows (1) an initial growth of the research disciplines, then (2) growing alliances with pure-science academic bodies, and finally (3) a weakening of the traditional focus on holistic physical education and sport, along with a disappearance of any professional relationship between the researchers and the field itself. The result is seeking alliances with medical fields, pursuing research that rarely helps the progress of knowledge in the field.

In striving to share the identity of more established fields of scientific research, physical education largely lost sight of its identity and of the purpose behind the discipline movement. The United States is an example of those concerns. There is now very little applied research because (1) universities want research grants to help fund their operations, (2) almost no money is available for research in physical education and sport, (3) the largest source of outside funds is medical research, so (4) to gain prestige, and research funding, researchers chase the money available for medical research. The result is that the field has less development of a Body of Knowledge than needed, a diminished supply of scholars active in field's needs, and the field has become fractured into specialties that share limited allegiance to the field. In short, the whole person is missing from much of our research. We need a renewed focus on the whole person, along with greater shared interests across a wide range of specialties.

Henry F M (1964). *JOHPER* 35(7): 32-33, 69

## P12Q-13

**Body and physical education: Conceptions, even today, presents****Queirós Paula, Garcia Rui**

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*Keywords: physical education, values, body*

The body is a prolific object for different analysis and a fundamental theme of current research. Since physical education practitioners are inescapably confronted with the body while carrying out their activity, they have to be aware of the importance the body possesses as a central category of this activity. So it is important to understand the conceptions about the body that the physical education teachers have. It is our interest, and it is the purpose of this study to explore the position of the body in a post-modern time from an axiological perspective, by looking through the lenses of practices (observation of classes) in physical

education, and to try to disclose possible avenues for physical education in our times.

Data for this study was collected from 6 schools in Grand Porto. One 9th grade class per school was selected and 10 class sessions were observed (amounting to 60 observations). In order to inspect the material we have used a phenomenological interpretation.

The analysis of the material reveals in general the biological/mechanical body category as the most important category, in the practical domain, which corresponds essentially to a Cartesian vision of the body. There are few references concerning the expressive body, and the experiential body category is almost non-existent at the practical level. The body as social construction, so important in the current discourse outside school, does not seem to deserve any relevance within school settings, which suggests that the awareness about the importance of physical education for the social construction of the body does not yet exist, or if it exists it is in a very thinned way.

The reflection of the analytical material allows agreeing with the arguments in literature, which claim that school, and physical education within school, remain enclosed in an axiological framework reported to modern times while the social context is already pointing in another direction.

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Fernández-Balboa J (1997). *Critical Postmodernism in Human Movement, Physical Education, and Sport*: 3-10.

Kirk D (1997). *Critical postmodernism in Human Movement, Physical Education, and Sport*: 39-63.

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## P12Q-14

**Values of PE and sport in local plans****Ekler Judit, Rétsági Erzsebet**

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*Keywords: physical education, local curriculum, primary school*

When the Bill of National Basic Curricula was passed in the Parliament in 1995, a feverish activity of planning commenced in Hungarian public education. New notions, such as Pedagogical Programme, local planning, and new tasks related to these notions occurred in the life of the Hungarian society of teachers. Since then a new curricula (Framework Curricula of 2000) has been issued, but it has not changed the essence of work; schools and teachers are expected to elaborate local curricula. The presence and future of particular subjects and areas of culture are significantly influenced by how efficiently the teachers can represent their interests at local levels. The situation is the same in case of PE as a subject.

The basic aim of this study is to gather data from the participating teachers and analyse the Pedagogical Programmes in order to gain information of practical significance for teacher training programmes.

Seventeen primary schools in Szombathely City, Hungary, were involved in the assessment. Gathering data was performed by interviewing teachers and analysing the annual Pedagogical Programme. It was studied in the Pedagogical Programmes how the values of PE as a subject appear in the system of aims (values, aims, tasks, forms of activities). Data related to the everyday sporting activities at the schools were obtained from the annual Programmes.

The obtained facts and figures were processed by analyses and statistical methods. SPSS programme was used for processing the data.

The "answers" can be summarised as follows: At first the schools do not represent PE as a subject according to its significance, second the Pedagogical Programmes and teaching practice at schools do not form a coherent unity and third representing interests and transferring values are unambiguously related to classroom teachers.

The results suggest the following recommendations: The would-be PE teachers should be prepared for being capable of actively participating in planning curricula and experts (teachers and sport experts) should be trained who, on the one hand, are aware of the motor, cognitive, affective and social values of sports, on the other hand, are capable of representing them.

#### P12Q-15

### Changes in pupils' fairness behaviour induced by moral education

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*Keywords: physical education, behavior, fairness*

Research points to the importance of Physical Education (PE) incorporating issues relating to fairness and fair play. However, until now no empirically validated research as to the effects of fairness education on pupils' behaviour has been reported. The aim of the study was therefore to compare the effectiveness of direct (explicit) fairness education with incidental (implicit) learning of fairness during PE lessons. The results presented in this paper focus on changes in pupils' fairness behaviour after a six week teaching unit.

A six-week longitudinal study was conducted with two seventh grade classes (age-range 12-13) consisting of 24 and 25 pupils respectively. In one class, the learning process was deliberately directed at improving pupils' fairness awareness (fairness education class, FEC). In the other class fairness was not explicitly discussed as a topic (physical education class, PEC). Pupils' behaviour during a handball tournament conducted before and after the teaching unit was filmed and evaluated both quantitatively and qualitatively in terms of fairness behaviour.

Quantitative evaluation showed a reduction of the number of hard and tactical fouls in both classes. The reduction in fouls per player was significant for hard and tactical fouls in FEC, but only for hard fouls in PEC. More players were integrated into the game in FEC following the teaching unit whereas there was little change in PEC. With regards to qualitative measures, noticeable differences in conflict solving as well as in the general atmosphere on and off the field were registered in FEC but not in PEC. In PEC, the focal point of debate between players on and off the field was mainly mutual blame in both pre- and post test. In contrast, whereas behaviour in FEC was similar in pre-test, there was a noticeable tendency in FEC to encourage team members in post-test.

Results indicate that the pupils' fairness behaviour can be very much improved through direct fairness education, whereas an incidental learning of fairness in PE does not appear to lead to an improvement in pupils' fairness behaviour. The results therefore lend support to the notion that PE lessons can benefit from explicit fairness education.

#### P12Q-16

### Gender differences in selected physiological parameters in young Greek children

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*Keywords: children, gender difference, physiological parameters*

There are a few studies that contain valuable information regarding physiological parameters in Greek schoolchildren (Manios and Kafatos, 1999; Tsiokanos et al. 2002). The purpose of this study was a) to reveal existing differences in a series of physiological parameters between pre-puberty Greek boys and girls in an attempt to improve the existing databases and b) to re-examine the physical exercise programs for schoolchildren by the training load point of view. Six hundred seventeen Greek schoolchildren 12 yrs old (364 boys: age  $12.3 \pm 0.5$  yrs; body mass  $49.9 \pm 11.6$  Kg; height  $153.6 \pm 7.6$  cm and 253 girls: age  $12.3 \pm 0.5$  yrs; body mass  $50.3 \pm 11.1$  Kg; height  $154.6 \pm 6.9$  cm) volunteered to participate in this study. The subjects performed a sit and reach test for estimating their flexibility, a basketball throw for power and strength of the upper limbs, a hand grip test for hand strength, a counter movement vertical jump for power and strength of the lower limbs, a 40 m sprint for velocity, a 10X5 m shuttle run for agility, and a Eurofit shuttle run test for aerobic capacity (estimation of  $VO_{2max}$ ). Furthermore, the BMI was estimated from the anthropometric measurements. Independent students' t-tests were used to assess differences in the measured parameters between boys and girls.

There were no significant differences ( $\alpha=0.05$ ) in mean values of BMI, and in the means of flexibility, hand grip strength, velocity and agility parameters. There were demonstrated significant differences ( $\alpha=0.01$ ) in mean values of the basketball throw ( $4.7 \pm 0.9$  vs.  $3.9 \pm 0.7$  m), vertical jump ( $32.3 \pm 6$  vs.  $29.3 \pm 5$  cm) and shuttle run for aerobic capacity ( $45.3 \pm 5$  vs.  $42.2 \pm 4.1$  ml/kg/min) tests, with the boys' scores greater than the girls' ones.

The above results indicate the superiority of the boys compared to girls (for this age group) in the upper and lower limbs' power and strength and in the aerobic capacity ( $VO_{2max}$ ). Furthermore, the present results indicate that when the aim of the school physical exercise programs is the improvement of  $VO_{2max}$ , power and strength of the upper and lower limbs then a gender individualization principle should be taken into consideration.

Manios Y, Kafatos C (1999). *J Sports Med Phys Fitness*, 39: 24-30

Tsiokanos et al (2002). *7th Annual Congress of the ECSS*, p 867, Athens, Greece

#### P12Q-17

### The promotion of an ethical behavior through the mechanism of controlling the rules of sport games

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*Keywords: competition, rules, behavioral control*

This work shows a the way in which sport activities can be characterized as competitive, self-overcoming, development of the personality of students, and helps forming the principles of behavior through mechanisms of control and

order imposed by the rules which lay at the basic of its progress.

It presents a way of understanding these rules and the importance given by pupils to different categories at different age and sex. There are relations between legal and moral rules that develop over time and complete as pupils learn not only correct behaviour, but also the ones of natural law.

Society and of course school, imposes a behaviour code which involves rules of conduct capable to induce and establish order. The status of allowing or forbidding actions in sports is relative because not in all situations an interdiction or permission is clear.

The paper's purpose is to gain insight in the domination that rules in sport games have and the permission to establish measures against violating those rules is appreciated by pupils at different age and sex.

A questionnaire of 20 items examined the importance that pupils give to: 1. Rules for correct conduct, 2. For those that impose the action, 3. For those that limit the game, 4. For the formality of the game and 5. For organizing and nominating the winners. The sample group consisted of 80 subjects, in grades 5 and 9, girls and boys, 20 subjects for each category.

Both age groups appreciated the organic law type rules. Pupils emphasized the way of organizing the contest and of nominating of the winner. The penal type rules are considered to be important too. Pupils sanctioned the forms that could be brought to teammates or contest mates for not respecting them. If they don't harm the partners they could not be considered as mistakes. The upper grade students appreciated the natural right type rules involving sportivity and fair play. Although the actual content of rules has no educational influence, our research leads to this conclusion: they develop connections between legal and moral rules; these two rules, by mutual completion lead to forming some compartments based on natural right type rules that contains an unforced behavior that respects itself as penal type rules.

## P12Q-18

### A model for specific warm-up for beginners in volleyball coaching

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*Keywords: volleyball, warm-up, beginner*

Coaches commonly believe that training in general, and beginner training, in particular, begins with a general warm-up, followed by a specific warm-up with and/or without a ball. This belief is expressed in a general warm-up which addresses different types of movement, and in a specific warm-up which addresses certain skills required for a game. These beliefs raise many questions regarding the connection, the attitude, the quality of delivery and the results of the general and specific warm-up in all training, but especially in training beginners. Furthermore, how does the warm-up turn from a guided process into an independent one? Based on his experience with training volleyball for beginners, women's volleyball in the Bundes-league and youth teams, in addition to training beginning teachers and trainers, Wertheim has developed an extensive model for the instruction of beginners (Wertheim, "The Integrative Approach", 2000).

The basic part of the model relates to the critical stage of the first lessons/training sessions, when the importance of the specific warm-up and its contribution to the learning and training of volleyball is taught. The specific warm-up model for beginners (Wertheim, 2002) focuses on a process based on the gradual transition that occurs in teaching and practicing a specific movement on the volleyball court prior to performing the skill, to the movement required at the time of performing the skill and in the movement following the performance of the skill with an approach to practice, an integrative approach and an approach to the game.

The model is based on four steps: 1. Practice getting a sense of the court, in general, and in changing situations, 2. Practice and handling of situations near the net and with the net, without a ball, 3. Practice getting a sense of the ball, in general, and in connection to movement on the court, 4. Practice getting a sense of the combination of court, net and ball.

*Wertheim M, Harrari I (2003). Physical Education and Sport, 67-69*

## Poster Session

### Physical Education and Pedagogics 4

**P12R**

#### P12R-01

### Moral values development through adapted physical activity: The effect of a moral education program

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*Keywords: moral education program, adapted physical activity, physically disabled adolescent*

The adapted physical activity is one of the most an important factors for increasing quality of the disabled integration process. A lot of researchers mentioned that adapted physical activity and disability sport is one of the greatest factors to improve disabled social integration into society.

The purpose of this study was to examine the effectiveness of a specially designed physical education program on the development of moral values of physical disabled adolescents.

69 physically disabled students at the age of 12-16 years, from two specials schools were investigated. Experimental group (n=35) was applied by a moral educational program over one school year (9 month). The other students (n=34) participated in the usual physical educational classes (control group). Moral values data were measured according to J. V. Podoliak (1989) "Doros" test. This test can be used for assessment of moral values of the student according 11 factors, which are ranged by factor's analysis method. Level of moral values was considered as low, lower than moderate, moderate, higher than moderate and high according to the different score of evaluation of the each factor. The statistical

reliability between results of experimental and control groups pre- and posttest was evaluated as influence of the program. Data of the study was evaluated by using SPSS 8.0 program for computing  $c^2$ , t, F.

Comparison of pre- and posttest mean scores suggest that a moral education program during physical education lessons has a significantly positive effect on changes of moral values in the experimental group, in such factors as honour and moral confidence ( $p < 0,05$ ), humanity and humanism ( $p < 0,001$ ), community and friendliness ( $p < 0,01$ ), respect to physical educator ( $p < 0,01$ ), self-control and self-discipline ( $p < 0,01$ ), behaviour in publicity ( $p < 0,05$ ). Pre- and post-test did not produce the desired significant differences between the groups in kindness to others. Fewer changes during the program were noticed in virtues of respect to women, religious conviction. Higher than moderate pre- and post-test results of the factors in both groups showed that students participated in our research have negative point of view to the values of sexuality, to drug and other toxin materials, although it was fix several cases of smoking habit.

#### P12R-02

### International comparison of PE: Concepts, problems and prospects

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Institute of Exercise and Sport Sciences, Switzerland

*Keywords: physical education, international comparison, concepts*

In recent years, physical education at schools has been confronted with serious challenges in a large number of countries. The need for savings, the expansion of established subjects, and the rise of new ones, have all challenged physical education to intensify reflections on its legitimization. In this discussion it is noticeable that the focus is mainly national, and that no serious attention is paid to experiences, measures or developments in other countries. Information from abroad could, however, be a considerable help.

We consider that too little is known about physical education in other countries. Comparative physical education is not generally part of the university curricula. Frequently, information about concepts and the current situation of physical education elsewhere comes only from a few professors or students who have returned from stays abroad. We believe it is time to bridge this knowledge-gap. This project aims to provide a contribution to this topic.

38 experts from different countries were invited to give their opinion following a qualitative questionnaire regarding concepts, problems and prospects of physical education in their homeland. Their answers should result in a strong survey of the situation of physical education all over the world. Since school systems are often hard to compare, the present comparison concentrates on students aged 10 to 16. Results are available at the earliest in autumn 2003.

#### P12R-03

### Testing of elite athletes at the training stages for the Olympics

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National Research and Practical Center of Physical Culture, Kazakhstan

*Keywords: testing, elite athletes, Olympics*

The purpose of the present research was to find adequate physiological and ergometric characteristics concerning the forecast of results of Kazakhstani skiers at the most crucial international competitions.

6 female and 7 male skiers had been examined twice at spring and autumn stages of the training period, with the use of discrete bicycle ergometer loadings of the growing metabolic capacity, including maximal. Parameters of breath and gas exchange were registered. Acid-base balance of blood including blood lactate was analysed. Under rest conditions and during test loadings ECG, PWC170, VO<sub>2</sub>max and physical performance at maximal heart rate, anaerobic threshold (AT) readings were recorded.

Two female skiers have obtained best results at the 2002 Winter Olympics. Their level of VO<sub>2</sub>max at the autumn stage of the training period was higher than VO<sub>2</sub>max among other Kazakhstani athletes for 10-15%, about 68-71 ml·kg<sup>-1</sup>·min<sup>-1</sup>. Physical performance at maximum heart rate was higher approximately for 10%. However, PWC170 level parameters were similar. Only three sportsmen from seven Kazakhstani athletes have shown positive results at the Olympics. The level of VO<sub>2</sub>max of those skiers at the autumn stage of the training period varied from 71 up to 82 ml·kg<sup>-1</sup>·min<sup>-1</sup>. PWC170 and the physical performance at maximal heart rate of the leaders of a national team on the average have appeared above, than at other sportsmen. At the same time it is necessary to note, that among the skiers, which unsuccessfully have taken part in competitions, there was a sportsman, who did not yield to the leaders of a national team on parameters of the VO<sub>2</sub>max, PWC170, AT.

The results of the carried out supervision have confirmed high prognostic importance of VO<sub>2</sub>max, AT, PWC170 at ski races, and also level of physical performance at maximal heart rate of sportswomen. At the same time among the sportsmen, which unsuccessfully have taken part in competitions, there was a sportsman, who did not yield to the leaders of a national team on parameters of functionality characteristics and physical performance. Hence, the achievement in ski races depends not only on functionalities reserve, physical performance, but also on other factors, revealing and which account will allow increasing efficiency of competitive result of the sportsmen.

#### P12R-04

### Comparing pedagogical content interventions of less and more experienced youth basketball coaches

**Pinto Dimas, Graça Amandio, Machado Miguel**

University of Porto, Portugal

*Keywords: coaching, basketball, pedagogical contents interventions*

The quality of the content and the mode of the interventions coaches directed to their players is at the heart of professional competence, and plays a critical role in the development of youth sport programs. For a long time, the study of teaching and coaching processes tended to focus on generic instructional and managerial variables, paying no

attention to the very content of subject matter or sports. Recently content has got an increased visibility in sport pedagogy research. The purpose of this study is to compare the pedagogical content interventions patterns of youth basketball coaches with contrasting coaching experience.

Two first year coaches and two more experienced coaches (> 5 years) working with 13 to 14 years of age boys competitive teams provided the raw data for this study. Data collection procedures included semi-structured interviews and systematic observations of video records of three coaching sessions per coach. The observation tool is an adapted version of the Systematic Analysis of Pedagogical Content Interventions (SAPCI) developed by Trudel et al. (1999). Data analysis is supported in qualitative descriptive tactics and quantitative analytical descriptive procedures.

Clear-cut distinctions between less and more experienced coaches are made apparent. More experienced coaches provided almost the double of pedagogical content interventions, and their instructions are much more focused on specific content. Both group of coaches put more emphasis on individual tactics. Further, more experienced coaches attend more to individual technique while less experienced coaches privileged team tactics.

Results suggested congruence between the goals and contents planned for the practice and the patterns of pedagogical content interventions actually observed.

*Gilbert W et al (1999). sosol, 2(2)*

#### P12R-05

### How do 12 year old secondary school students appreciate physical education programs?

**Graça Amandio, BrandãoD Dulce**

University of Porto, Portugal

*Keywords: physical education, attitude, secondary school*

The purpose of this study is to identify secondary school students' attitudes towards physical education school programs. We intend to identify students' perceptions about the most important goals for physical education; about the factors of agreeability and disagreeability in physical education classes and about the importance physical education plays on students' personal development. We want to address the impact of the students' evaluations on prior experiences in physical education, and the impact of the mismatch between the students' appreciation of the perceived physical education curriculum and the curriculum they would prefer upon students' attitudes towards the physical education programs.

Secondary school year-12 students (n=410) of both genders, ages between 16 and 20 years, attending official schools of Gaia, a Portuguese municipality close to Porto, filled the Students Attitudes towards Physical Education questionnaire developed by Tannehill et al. (1994). Data analysis included descriptive and inferential statistics procedures, Independent T test, Pearson correlation coefficient, Fisher's Z, and logistic regression.

In general, year-12 students, and more emphatically boys, have a positive attitude towards school physical education. They disapprove reduced time schedules for physical education. Students give preferentiality to diversified curriculum activities, and value co-educational environments higher. Being successful in the activities is the most significant predictor in the development of gender distinctive attitudes. Curricular content is a critical variable for positive and negative experiences in physical education classes. Games are the favoured content and the mastery of game

skills is a legitimate goal for physical education. The perceived importance of physical education is the most significant predictor in developing attitudes towards the decision of attending physical education.

Results do not confirm pessimistic conclusions suggested by other studies (Brown, 1992; Jones & Cheetham, 2001). Although most of the boys and girls have a positive attitude towards the goals and contents of the physical education program, there are some differences in their evaluation criteria, and interests.

*Browne J (1992). J Teach Phys Educ 11, 402-410*

*Jones R, Cheetham R (2001). Eur J Phys Educ 6, 81-100*

*Tannehill D et al (1994). J Teach Phys Educ 13, 406-420*

#### P12R-06

### The learning environments influence to the development of motor abilities and physical activity

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*Keywords: physical activity, motor abilities, children*

There has been an increase of the interest to identify the factors responsible for developing and maintaining the physical activity and motor abilities of children. It appears to be a function of various factors, including heredity, biological and psychological variables, and the physical and social environment. Social factors appear to be the most influential on children's physical activity (Sallis et al., 1993). However, we do not know the varying effects of learning environments to physical development in children with the same age. The aim of this study was to assess the difference of physical activity and motor ability of peer groups influenced by learning environments.

The kindergarten children (n=35) are learning in preschool condition. The school children (n=152) have begun their studies at school. After the year, the motor ability tests from Eurofit (1988) tests battery were used, in spring. A 3min endurance shuttle run was also used (Kaneko, Fuchimoto, 1992). Children's physical activity was registered using the questionnaire of Harro (1997). Descriptive statistics included means ( ) and standard deviations (SD). Independent t-tests were used to make statistical comparisons between groups.

School children had better results in sit-ups and plate tapping tests. There were no significant differences in other motor ability tests between the groups.

School children were physically more active in outdoor activities on weekdays and on weekends. Kindergarten children spend more time in indoor activities on weekends, compared to the same age school children.

The environment conditions have effective influence to the children's development, if they are considered to mature level and the needs of children. Under the present scheme of day, our children in kindergarten and school have similar indoor activities on weekdays. The results on motor abilities of school children indicate that learning environments in PE are not sufficient



## P12R-07

**Profile of the candidates according to the SSIS-Lazio**

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*Keywords: teaching*

Development of courses, aiming at the qualification of Physical Education teachers, within the Italian first and second grade Secondary School System, is organized by the State Universities the last two years (as accordingly to D.M. 26 Maggio 1998).

A research study conducted by Motor Science SSIS-Lazio in collaboration with the IUSM (University Institute of Motor Sciences) of Rome, has defined the profile of the ideal candidate.

The information has been collected by filling in a multiple choice questionnaire. The study has been conducted on 240 candidates. Instructions to fill in the questionnaire were given to each candidate, each of them having no limitation of time in answering the 18 questions. After sorting out by topics, the collected information was reported on boards and graphics together with the averages and percentages estimated.

The results of this study show that the number of candidates tested were 136 females (56.67%) and 104 males (43.33%), with an average age of 29 ( $\pm 4,34$ ) in particular the males being 30 years old ( $\pm 4,55$ ) and the females being 29 years old ( $\pm 4,14$ ). Most of the candidates (124 (51,67%)) holding a ISEF Diploma attended Istituto Superiore Statale of Rome and most of the candidates (37 (45,68%)) with a Degree in Motor Sciences attended the IUSM (Istituto Universitario di Scienze Motorie) of Rome. A group of 167 students (30,47%) had no agonistic professional experiences, 135 students (24,64%) worked in Summer Camps (Centri Estivi), 94 persons (17,15%) had agonistic experiences, a group of 83 (15,15%) was of older age, and a group of 69 (12,59%) was disabled.

The average working period in Public Schools was two years and four years in Private Schools. The final profile of the ideal candidate is a female in her thirties, with a secondary school education, holding an ISEF diploma, a Degree in Motor Sciences and having achieved private working experiences both at schools and on a sports base.

## P12R-08

**Motivation to attend sport lessons of different profit: Latvian school students in various age periods**

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*Keywords: motivation, health level, attitude*

Sport exercises and various physical activities promote the all-round development of child's personality. Student's interests and motivation to go in for sports as well as interrelations between teacher and pupils determine the effectiveness of sport lessons. It is influenced by student's age, school's profile, skills and abilities of teacher to raise interest of students, sport's inventory and other factors.

A questionnaire with more than 200 students was carried out during this investigation. The attitude of various age (5th, 6th, 8th, 10th, 12th grade) students to sport lessons was compared. The 5th grade students' attitude to sports in

general education school was compared with the same age student's attitude to sports in school with art profile.

The results of investigation clarified that the majority of students like to go in for sports. The majority of students go in for sports in order to improve their health level (in the 5th grades approximately half of the students but in the 12th grade of general education school 80% of students have this motivation). The greatest part of students who point out that sport is one of the main passions of their lives is among 8th grade students (19%). In the 10th grades 20% of students but in the 12th grades 50% of students mark out that they are not fascinated by sport. Nevertheless, a number of students who attend sport lessons only in order to pass a test in sports is not very big (17% in the 5th and the 6th grades of the generally education school). During sport lessons most of all students like to play sport games. The most popular sport game is basketball. The majority of students consider that the preparedness of sport teachers is enough to lead sport lessons. Such opinion is more expressed in lower grades. The greatest motivations to go in for sports have the 8th grade students. In the older grades student's interest to sport reduces but in the younger grade pupil's interest has not appeared yet in such a great extent.

In general there is no great difference in attitude to sports and motivation to attend sport lessons among general education school students and students of art profile school. The majority of students consider it necessary, in order to raise young peoples interest in sports to give children the opportunity to go into various branches of sports in their spare time without charge or for low payment.

## P12R-09

**The validation of a questionnaire as measurement tool to examine coach profiles and their influential variables**

**Feu Sebastian, Ibáñez Sergio José, Graça Amandio, Pinto Dimas**

University of Extremadura, Spain

*Keywords: coach profiles, questionnaire, validation*

Literature provides us with several ways for typifying coaches in accordance with some specified criteria. Ibáñez (1996) identifies six theoretical coach profiles: the traditional, the technological, the innovator, the collaborator, the approachable, and the critical coach. These coach profiles are defined according to the following parameters: coaching philosophy, coaching style, employed training means and equipment, coaching climate, relationships with staff, and relationships with players. The author considers that any of the coach profiles is affected by the following influential variables: the attitude on decision making, the planning style, the formative experience, and the degree of commitment. The purpose of the present study was to develop an instrument to examine the coach profiles and their influential variables.

## P12R-10

**Motives in post-modern dance such as contact improvisation**

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Institute of Sport Science, University of Innsbruck, Austria

*Keywords: motives, dance, improvisation*

The field of research in the area of motives shows that about the post-modern dance, no empirical investigation results

have come in yet. The present study intends to clarify which motives are significant for this dance form.

99 dancers, who carry out contact improvisation on a regular basis, were examined ( $n = 99$ ; age =  $32.6 \pm 5.9$ ). Within the scope of a questionnaire investigation the subjects were confronted with open items concerning motives to contact improvisation. They were requested to answer them in written form. By means of qualitative content analysis (Mayring 1997) and quantitative evaluation 11 relevant motives could be extracted, of which the 8 most significant motives were chosen for further investigation. The subjects were asked to evaluate the importance of these 8 motives on a six-level scale. SPSS- package was used for data processing.

The evaluation of motives within the whole group shows the following order: 1. excitement; 2. motion experience; 3. independence; 4. creativity; 5. non-verbal communication; 6. self-experience; 7. fitness; 8. relaxation. The sex-specific comparison (female:  $n = 56$ ; age =  $32.2 \pm 5.6$  and male:  $n = 43$ ; age =  $33.5 \pm 6.4$ ) shows a significantly higher evaluation of "independence from motion instructions" (sign. = 0.026) by women than by men. All other motives don't show any significant differences. The comparison between levels of abilities (slightly advanced:  $n = 30$ ; age =  $30.7 \pm 6.4$  and experts:  $n = 69$ ; age =  $33.5 \pm 5.6$ ) shows significant differences regarding the motives "independence from motion instructions" (sign. = 0.022) and "self-experience" (sign. = 0.024). "Independence from motion instructions" (improvisation) and the aspect of "self-experience" is significantly more important for the group of "slightly advanced" subjects.

The results show (even in comparison to the quantitative evaluation of the written data) a surprisingly high correspondence - even concerning the rank order - of the individual motive areas of men and women. This indicates that within contact improvisation both men and women have similar motives to turn to this kind of dance form.

Mayring P (1997). *Qualitative Inhaltsanalyse*. Weinheim/Basel: Deutscher Studienverlag.

#### P12R-11

### Differences in HR during field endurance test among school aged children

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The Teachers Professional School of Higher Education, Croatia

**Keywords:** heart rate, children

HR monitoring has become one of the most popular methods for assessing the physical activity in children and the overall estimation of the exercise intensity.

150 boys and girls from 5.th to 8.th grade were participating in the test. The test was carried out using the rounded track where children had to run for 6 min. HR was recorded 1 min before, during the 6 min of running and 1 min after. Resting heart rate (RHR) was taken in the morning after lying at rest for 10 min.

Analyzing the reasons for differences between boys and girls we can speculate according to (Rowland et al 2000) that maybe the fitter children, boys in this particular case, spent more time at lower HRs due to higher SV. Another speculation can be given, (Bar-Or 1987), that the metabolic cost of running or walking is considerably higher in children than in older age groups, that younger children get tired sooner than the older. In same way girls probably get tired sooner than the boys. We can't disregard many other

differences between sexes, not only in the constitution but also in the size and the functional capabilities of the heart.

Armstrong N et al (1991). *Eur J of Appl Phys* 62 (5): 369-375

Bar-Or O (1987). *RQES*, Vol 58, No. 4, 304-307

Cheatham C et al (2000). *Med Sci in Sports Exercise* v. 32 no 6

Rowland T et al (2000). *Med Sci in Sports Exercise* V. 32 no 2, 253-9

#### P12R-12

### Personal models of teaching volleyball in competitive settings

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**Keywords:** teaching, volleyball, personal models, competitive settings

The sport training process with youngsters demands that the coach possesses professional competencies necessary to produce a significant impact on the development of players. Desirable technical and pedagogical capacities are critical to promote a positive sport experience and to enhance the actualization of players' performance potential. How those expected coaching competencies shapes coaches' intervention is badly documented. This study intends to query the methodologies adopted by the coaches during the coaching-learning process of youth volleyball teams.

This multiple case study involved four youth volleyball coaches from the North of Portugal. The coaches aged 24 to 37, played volleyball for more than 10 years, and have 4 to 11 years of coaching experience. Data were collected through 2 semi-structured interviews, and observation of video records of a week training unit (3 sessions) for each coach. Data were introduced in Nudist 4 for qualitative analysis. Viera & Ferguson's (1989) Structure of knowledge of volleyball, and Mesquita's (1998) Model of tasks in team sports constitute the theoretical framework that assisted data codification and interpretation.

The four coaches shared similar conceptions about the relevant content in coaching volleyball. They recognize the relative importance of the tactical and technical elements to improve the players' performance. They stress the mastery of the game skills through modified game situations. They emphasize the manipulation of the game structural factors (number of players, size of the court and rules adaptation). However, during the observed practice the least experienced coach used mostly formal game (6x6) and analytic drills. Conversely, the more experienced coaches manipulate the degree of complexity of tasks in a progressive way. All the coaches sustain a step-by-step for tasks progression, but the least experienced coach introduced a new skill (block), applying more complex drill on the first and second sessions. The most remarkable factor that distinguishes the least experienced coach is the apparent degree of incongruence between the espoused perspectives and the implemented decisions.

Viera B, Ferguson B (1989). *Teaching Volleyball. Steps to success*

Mesquita I (1998). *Instruction and task structures in volleyball coaching. Unpublished doctoral dissertation. University of Porto, Portugal*

## P12R-13

**Physical activity for adults' training and education****D'Onofrio Marina**

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*Keywords: adult education, integrated planning*

One of the most important challenges for the developed countries is to create an integrated system which would involve the public bodies responsible for education, for professional training and for employment services, as well as the companies, the associations and the local bodies, and which could also guarantee to anyone and at any time the right to education and learning.

In this context, the science of the movement - a sure reference in terms of psycho-physical efficiency, well-being, beauty treatment and food health - has to play a fundamental role in adults' informal education.

These statements, which are confirmed by the analysis of the preliminary results of a recent survey evaluating the motivations of the adults involved in Long Life Learning (LLL) activities, show the necessity of undertaking initiatives aimed, on the one hand, at a professional qualifying and up-dating of adults' physical education teachers and instructors, and on the other hand, at defining specific physical and recreational activities inside LLL educational and training courses.

Two intervention projects have been worked out. First, a pilot project which proposes a combined training involving both the LLL system's teachers of physical education and the III sector's (social and no profit companies) instructors. And second, a project that concerns directly the users of any LLL activity, as a kind of informal educational opportunity.

The planning methodology of both the projects is mainly based on the concept of "training's pedagogical quality" but also takes into account all the criteria, the modalities, the strategies and the resources useful for a possible improvement in the education of the subject.

The subjects involved in both the projects are, besides the IUSM of Rome, the I.T.I.S. Armellini in Rome (Evening course for Adults) and the CTP N.7 (Local Authority for Adults' Permanent Education).

*D'Onofrio M, 2001: Motivazioni alla partecipazione ad attività di educazione degli Adulti ed aspettative di carattere motorio-ricreativo.*

*Pitoni I, 1998: La qualità dei progetti di formazione.*

*Montedoro C, 1998: Elementi di progettazione integrata per la formazione di qualità.*

*D'Onofrio M, 2001: Flessibilità e didattica modulare per un corso di ginnastica ritmica finalizzato.*

## P12R-14

**Pedagogical contents interventions of roller-skate hockey coaches: Comparison between training sessions before and after competition****Mesquita Isabel, Cruz José**

University of Porto, Portugal

*Keywords: coaching, roller hockey, pedagogical contents interventions*

The purpose of the present study is to investigate the questions related to the pedagogical content interventions of coaches in roller-skate hockey sessions training. We describe the information transmitted by the coaches during the training sessions on contents of technical and tactical

order (in other words, "what"); as well as identifying "when", "how" and "to whom" the contents in question are directed. We also determine to what extent the moment when the session takes place (immediately before or after a competition) may influence their pedagogical content interventions.

The sample includes all the coaches (n=12) of 12-14 years team league of the Minho Roller-Skate association, in the season 2001-2002. We applied an observation system - SAPCI, Systematic Analysis of Pedagogical Content Interventions instrument (Gilbert et al 1999). Descriptive and comparative statistics were used.

During training sessions, coaches focus their pedagogical content interventions on technical and tactical matters mainly related to offensive action. Concerning the moment when the coaches give the information, they prefer to transmit information when players are in action. They prefer to give information in the form of specific instruction. Coaches' favour approaching players on an individual basis. On the session before the competition, coaches give significantly preference to collective tactic and after the competition they focus on offensive technique.

There were no significant differences on the dimensions "when", "how" and "to whom", between sessions before and after the competition. However, on the dimension "what" we found significant differences: in the session that precedes a competition coaches give a preference to collective tactic information and in the session after the competition the information emphasises the offensive technique.

*Cruz J (2003). A intervenção pedagógica do treinador de Hóquei em Patins. Tese de Mestrado não publicada, FCDEF-UP, Porto, Portugal*

*Gilbert W, Trudel P (2001). Journal of Teaching Physical Education, 21: 16-34*

## P12R-15

**A comparative analysis focusing on problem solving skills of first year students, male and female, majoring in physical education, in the framework of a PE teacher role-play****Szatmári Zoltán, Katona Zsolt, Vass Miklós, Papp Gábor, Prisztóka Gyöngyvér**

University of Szeged, Hungary

*Keywords: behavior, attitude, students*

Nowadays, teacher training institutes lay more emphasis on the implementation of overall personality and behaviour development of Physical Education teachers and on making such developmental programs more efficient. In our research, we examined and observed the personalities of Physical Education trainees within the frame of various educational styles. We have compared the male and female trainees with the aim of revealing any differences that might occur in the problem-solving strategies during the role-play situations and finding which groups' solutions prove to be more efficient.

Our research is based upon a questionnaire describing ten conflict situations of which the occurrences are typical and frequent in Physical Education lessons in primary schools. These highly emotional situations are disruptive and so demand immediate reactions and solutions on the teacher's part. After interpreting the situations, the research subjects give a brief description (about ten sentences) of their own solutions. The answers are categorized into ten educational styles. The basic categories are the following: aggressive, restrictive, co-operative, inertial and indifferent behaviour.

We assume that the analyzed data will indirectly reveal what differences there might be between the educational styles of

male and female Physical Education teacher's trainees. The aim of our project is to enhance future Physical Education teachers' efficacy in terms of personality skills and behavioural patterns so that pedagogical work will have a direct impact in a real classroom situation, i.e. in a given class, group or in case of an individual pupil.

#### P12R-16

### Identification of the genetic profiles - aerobic resistance and somatotype type - characterizing male athletes with high income in Brazil

**Fernandes Filho José, Dantas Paulo**

Castelo Branco University, Brazil

*Keywords: physical fitness, dermatoglyphics, futsal*

The study in focus is centered in the identification of the genetic profiles, of aerobic resistance and somatotype type that characterize masculine athletes, of high income, participants of the adult futsal in Brazil.

To present research it has the descriptive stamp with profile typology. N=66 \_ athletes high income adult futsal in Brazil. Dermatoglyphia (CUMMINS & MIDLO, 1942); MULTITAGE FITNESS TEST (NATIONAL COACHING FOUNDATION, 1998); and somatotype (ISAK, 2001). The descriptive statistics, structuring in medium values and yours derived. The dispersion analyses, combined to the curtose test.

To observe to the literature corresponds the pattern, for the sports of games and resistance of speed, as it describes (ABRAMOVA and col., 1995).

The possibility of aggregation of the dermatoglyphis to be demonstrated, as one more protocol of evaluations, especially, for the futsal. The one that, in last analysis, it would confirm the dermatoglyphis, also inserted, in Ergometric motricity.

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#### P12R-17

### Patterns of play of international rugby union teams before and after the introduction of professional status

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*Keywords: patterns of play, international rugby union, pre- and post-professionalism*

Anecdotal evidence would suggest that since the introduction of professional rugby union, the game has become more intense due to increases in total activity duration and speed of play. Analysis using a modified time/motion approach specifically relating to activity times may provide detailed information on the relative intensity of the game. The purpose of this study was to compare the time in activity

(using videotaped recordings) of International Rugby Union teams in discrete periods spanning the inception of professional rugby in the mid 1990's.

Individual activity times (initial possession to completed tackle) were recorded for six pre-recorded matches (3 during 1988 and 3 during 2002) taken from the Five and Six Nations respectively; using a standard lap split time stopwatch and hand notation system. Intra-Class Correlation ( $r = 0.99$ ,  $p < 0.05$ ) between two separate observations of activity times suggests very high intra-observer reliability. Further analysis indicated that mean differences between observations were greater than 95%.

Comparisons of mean differences using the Mann-Whitney U statistic ( $U = 154759.5$ ,  $p < 0.0001$ ) revealed the mean activity time for games during 1988 ( $6.83 + 4.56$ ) to be significantly higher from mean activity time during 2002 ( $5.51 + 3.49$ ). However, the total activity time in both first and second were found to be higher during 2002 accompanied with a 28.2% increase in game total activity since 1988.

It was concluded that since the inception of professional status in rugby union, the time players spend in game activity has been significantly reduced, whilst total game activity has been increased.

#### P12R-18

### Psychophysical role of culture in the development of personality in Russia

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*Keywords: psychophysiology, school children, self-realisation*

Physical culture of the last decades has lost humanity potential. A new conception of the physical culture has become necessary for personal development of schoolchildren. At the basis of this ideology we see schoolchildren as a "psychophysical subject of self-intelligence" but not as an "object of sanitation".

The program of psychophysical culture included aerobic lessons with performance on an annual festival. More than 100 schoolgirls have taken part in the research. As control group girls of 10-11 classes were chosen, who were engaged in the traditional program of the physical education? The attitude of the schoolchildren to lessons of physical culture and psychophysical culture was studied with help of a method of the value - motivation orientation.

Among the most important motives to learn psychophysical culture are such motives as development of abilities 33 %, perfection of personal qualities during independent work - 20,5 %, interest to physical activity - 17,7 %. The results in control groups have shown that in the 10th class 34 % of the schoolchildren have internal motives (interest to subject, development of abilities), in the 11th class 84 % of the schoolchildren have only external motives (aspiration to receive a positive estimation, performance of the school program). The principal motives of schoolchildren to perform at a festival are: 1st place - motive of the self-assertion, the desires to impress the spectators; 2nd place - motive of interest and perfection; 3rd place - aspiration to a victory, desire to win or to take a prize-winning place. It is necessary to note, that a positive estimation is completely irrelevant for the given schoolchildren. These results testify that preparation and performance in a festival are only connected with the personal motivation. Therefore, it is not casual that the time that schoolchildren have for preparation for a festival is not limited only by the lessons of physical culture. The preparation for a festival lasted after lessons (at home at hostel and other places). All preparations for the festival were

completely independent, without management of the teacher. It is obvious, that it is exactly the independent activity that will promote development of a number of personal qualities of the schoolchildren. It was found out, that application of psychophysical culture helps to improve such psychological qualities as: confidence (94,7 %), feeling of a rhythm (84,2 %), plasticity (73,6 %), responsibility (73,6 %), skill to cooperate (73,6 %).

The received data allow considering, that psychophysical culture create conditions for creative self-realization of schoolchildren on the basis of values of the youth culture. It provides personal development and increases culture potential of the schoolchildren.

#### P12R-19

### Student games of "regione lazio": analysis of performances of track-and-field sports

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*Keywords: motor skill, track and field, young students*

The observation of any kind of phenomenon is always very important to value the strategies utilized and the determination of adaptations. In the circle of Student Games, the observation and the analysis of the results can permit to verify the didactic choices of the Physical Training Teacher and the ministerial programmes. Data retrieval of "Regione Lazio" enables a positive confrontation with the other Italian regions' data and with similar studies at international level. This study has permitted to establish straight relationships between the University Institute of Motory Sciences, Federal Sport Structures that manages the Games, Ministry of Education and Rome Education Office. In this way a constant monitoring is guaranteed.

The analysis of the Games has concerned many athletic disciplines: here, the analysis has been done specifically on Long jump and High jump. These disciplines have been chosen for the greater availability of attendance data. The age taken into consideration is from 13 to 17, boys and girls, divided into Cadets and juniors. All data have been computerized with Excel and studied from a descriptive and comparative point of view with SPSS.

The Anova value for the referenced years for the results of the same disciplines in Juniors category points out an absence of significancy (Anova Tab.); in the Cadets category, la p results are significant in female Cadets high Jump ( $p=0,017$ )

To sum up we can suppose that the absence of significant differences in performances during the years is logical for the following reasons: a) Juniors category (15-16-17 years) is represented by persons with a greater experience obtained from the previous years and with a constant technical preparation; b) the participation to these events at this age, shows a real motivation to the event; c) in the majority of the cases, girls have completed the growth process. Concerning Cadets category (13-14years) the Long jump (both male and female) is the only specialty that does not provide meaningful differences. On the contrary, for the Long Jump (female cadets), the performance instability during the years can be justified: a) because the first competitive experience in the Games is stimulated more by the teacher than by the

personal choice of the teenager; b) the difficult emotional status does not help the performance; c) the insufficient technical efficiency; d) the presence of strong and different personal pushes to the growth process.

#### P12R-20

### The relationship between young people's physical activity levels and attitudes towards physical education

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*Keywords: physical education, physical activity, attitude*

Recent research suggests that patterns of health related behaviours are often acquired and established during childhood and adolescence and physical education has the potential to foster positive attitudes towards participation in physical activity (Sleep & Warburton, 1992). The aim of this study was to assess the relationships between young people's physical activity levels and attitudes towards physical education.

Three hundred and ninety four British school children (134 boys & 260 girls) from school years 7, 8 and 9 (age:  $12.89 \pm 1.61$  yrs) participated in the study. Informed consent was obtained from participants and parents. Physical activity was assessed using the Four by One-Day Recall questionnaire (Cale, 1994). Attitude was measured using the Pre-Adolescent Attitude Towards Physical Education Questionnaire (Shropshire, 1997).

Weak but significant positive relationships were evident between the general interest factor and energy expenditure ( $r=.179$ ,  $df392$ ,  $p<0.01$ ), time spent in moderate activity ( $r=.131$ ,  $df392$ ,  $p<0.01$ ) and vigorous activity ( $r=.197$ ,  $df392$ ,  $p<0.01$ ). Significant positive relationships were also revealed between: the assessment in PE domain and moderate activity ( $r=.118$ ,  $df392$ ,  $p<0.05$ ), the PE teacher domain and average daily energy expenditure ( $r=.122$ ,  $df392$ ,  $p<0.05$ ), the PE teacher domain and vigorous activity ( $r=.155$ ,  $df392$ ,  $p<0.01$ ). Total attitude towards PE was significantly related to average daily energy expenditure ( $r=.159$ ,  $df392$ ,  $p<0.01$ ), time spent in moderate activity ( $r=.122$ ,  $df392$ ,  $p<0.05$ ) and time spent in vigorous activity ( $r=.182$ ,  $df392$ ,  $p<0.01$ ). Individuals who hold a more positive attitude towards the subject were found to be more physically active.

Furthermore, results suggest that vigorous activity is more popular amongst individuals who hold a positive attitude towards their teacher. However, environmental adjustment and organisational choice domains show no association with activity variables. Therefore one could question whether contextual factors foster negative attitudes towards PE.

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## Poster Session

## Sports Medicine 5

P12S

P12S-01

**Impact of physical activity and psychological stress on resting secretory immunity****Aird Jeff, Flouris Andreas, Inglis Greig, Klentrou Panagiota**

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*Keywords: physical activity, immunity, psychological stress*

Psychological stress is known to activate the HPA axis resulting in cortisol secretion. More specifically, studies examining academic stress report an increase in salivary Immunoglobulin A (sIgA) secretion rates. Conversely, it has been demonstrated that as cortisol levels increase, immunosuppression of sIgA is evident. In response to these inconclusive findings, the present study attempted to determine the effects of salivary cortisol on salivary immunoglobulin A (sIgA) and frequency of Upper Tract Respiratory Infections (URTI) in University age students at the beginning and the conclusion of an academic term.

Fifty (50) University students (27 males, 23 females) who had not received a flu vaccination for the past 12 months participated in the study. They were assessed for sIgA, sIgA/albumin ratio, and salivary cortisol. Each subject completed the Aerobics Center Longitudinal Study Physical Activity Questionnaire for estimation of weekly energy expenditure, and an 11-week Health and Sickness Log for daily recording symptoms of sickness. The first test was completed in September (T1), a relatively low stress period, and a follow-up test was completed in November (T2), two weeks prior to the term final examinations.

Analysis of variance indicated no significant ( $p > 0.05$ ) differences in sIgA concentration ( $210.36 \pm 155.91$  vs.  $220.93 \pm 157.39$ ) and sIgA/Albumin ratio ( $2.84 \pm 0.72$  vs.  $2.84 \pm 0.79$ ) between T1 and T2. Salivary IgA was not related to weekly energy expenditure in this age group ( $p > 0.05$ ). However, when comparing the data to the normal population values, the students were below "optimal" levels for the recommended physical activity levels based on the average weekly energy expenditure (kcal/kg/min), while at both T1 and T2 their sIgA concentration was significantly lower ( $p < 0.05$ ) than previous reports in the literature. This indicates that the subjects were overly stressed since the beginning of the year, which possibly resulted in immunosuppression. This down-regulation of the immune system is evident in the high average number of total sickness days of 11.04 over the eleven-week period. No gender differences in sIgA and URTI frequency were detected ( $p > 0.05$ ).

*Results from this study suggest that low levels of physical activity and psychological stress have a significant effect on the immune system. It seems reasonable to suggest that strategies highlighting healthy lifestyle patterns in students are necessary.*

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P12S-02

**Relationship between %HR reserve and %VO2 reserve during arm paddling exercise in surfboard riders****Mendez-Villanueva Alberto, Perez-Landaluce Javier, Fernandez-Garcia Benjamin, Ortolano Raquel, Terrados Nicolas**

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*Keywords: heart rate reserve, arm paddling, surfing*

Based on the linear relationship between HR, work rate and VO2, a percentage of HRpeak (%HRpeak) to elicit a determinate percentage of VO2peak (%VO2peak) has been used to assess cardiovascular stress. Using this approach, HR values usually overestimate the exercise intensity in VO2 terms. HR reserve (HRR) was then introduced, showing that %HRR values are closely related to the values of VO2 reserve (%VO2R) using lower body exercises in untrained population. The purpose of this study was to determine whether %HRR was equivalent to %VO2R in a sample of highly trained competitive surfers during a specific upper body exercise.

Thirteen highly trained competitive surfers performed a continuous incremental arm paddling exercise test on a modified kayak ergometer. HR and VO2 values for the end of each stage were expressed as a percentage of HRR, VO2R. A linear regression was performed for each subject (%HRR versus %VO2R). Average line was obtained from individual regression lines by calculating the average intercept and the average slope from the corresponding values of the individual lines. Additionally, a paired t-test was employed to determine whether the mean ( $\pm$  SEM) values for intercept and slope of the linear regression of %HRR- %VO2R differed from 0 and 1, respectively (reflecting a difference from the line of identity).

The regression for %HRR predicted from %VO2R did not coincide with the line of identity. The mean value of the intercept was significantly different from zero ( $P < 0.001$ ). Further, the mean value of the slope differed significantly from 1 ( $P < 0.001$ ). The %HRR - %VO2R relationships yielded the following regression equation: % HRR =  $0.95 (\pm 0.06)$  % VO2R +  $14.40 (\pm 4.38)$ .

Previous studies that examined the relationship between %HRR and %VO2R employed exercise protocols involving lower body, demonstrated an equivalency between %HRR and %VO2R values. Our findings, along with those reported by Rotstein and Meckel (2000) seem to confirm that when a small muscle mass and/or upper body is used, the accuracy of the prediction of % VO2R from % HRR is decreased.

Rotstein and Meckel (2000). *Eur J Appl Physiol* 83: 545-50

## P12S-03

**Exercise capacity in Austrian ice hockey players**

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University of Vienna, Austria

*Keywords: ice hockey, VO2*

Aim of the study was to evaluate the exercise capacity of Austrian ice hockey players.

Twenty-two Austrian ice-hockey players (mean age  $24 \pm 5$  y) performed a symptom-limited incremental maximal exercise test with gas exchange measurements in order to determine maximal work rate (Wattmax) and peak oxygen uptake (VO2peak). Every two minutes the load was increased by 50 Watt. Pedaling rate was constant by 70-80/min. Maximum exercise capacity was presented as percentage of predicted value depending on age, gender and body surface.

Measured parameters on each step and on maximum capacity were heart rate by ECG, blood pressure and minute ventilation (VE). Oxygen uptake (VO2) and CO2 output (VCO2) were measured by breath by breath method (Sensormedics 2900 Metabolic Measurement Cart).

The average of exercise capacity was  $155 \pm 15\%$  of normal values compared to healthy, untrained age, weight and height matched persons. The peak oxygen uptake (VO2max) was  $49.6 \pm 4$  ml/min/kgKG with Wattmax of  $361 \pm 38$  Watt. The maximal increase in lactate concentration during exercise was  $13 \pm 2$  mmol/L, with maximal heart rate (HRmax) of  $184 \pm 6$  b/min. When divided in two groups, in the first group with an exercise capacity of over 155% (GROUP I) and in the second group with an exercise capacity of less than 155% (GROUP II), there was a higher increase of VO2 on each step with lower increase of heart rate and lactate concentration in GROUP I compared to GROUP II.

The exercise profile of ice hockey players represented a VO2max of at least  $49.7 \pm 4$  ml/min/kgKG with a maximum work load of 360 Watt corresponding an exercise capacity of 155% compared to age, height and weight matched untrained persons.

## P12S-04

**Physical activity and condition of medical students**

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*Keywords: physical activity, fitness, medical students*

The purpose of the present study was to measure selected anthropometrical characteristics, motor abilities, and cardio respiratory functions of medical students.

Eighty-seven students were involved in this investigation. The students were categorised into five groups: (1) recreational, doing sport activities irregularly, (2) basketball, and (3) handball players, having training at least two times per week, as well as male (4) and female (5) students at the entrance to medical school. Anthropometrical and physiological measurements, as well as static and dynamic motor test were used. The examination of the subjects started by recording the personal data followed by anthropometrics, dynamometry, and measurement of cardio respiratory functions. Thereafter the motor tests were performed in the gymnasium. Descriptive statistics and ANOVA were used for statistical analysis.

In all groups, the means of the body mass indexes and waist-to-hip ratios were at the upper level of the normal range,

while body fat percentages were around the middling compared to standards for sedentary subjects. Better motor performances were obtained from the basketball and handball players than from the others. The static strengths were somewhat above the normal sedentary level. The resting blood pressure and heart rate were normal. However, cardiovascular risk factors were found in six students. Their systolic blood pressure was above 140 mm Hg. Low blood pressure did not occur. The heart rate was elevated in three students of the recreational group, and in women. Bradycardia did not occur. The vital capacity and the breath holding were at the upper level of the normal range. It is worth mentioning that slight but statistically significant differences were found between the groups in all cardio respiratory parameters except the diastolic blood pressure. It has almost the same value in all groups.

The present results show that the physical condition of our medical students is below the level desired for a young, athletic man. Their physical activity is behind the optimum for health promotion. These results give emphasis to improve the students' prevention oriented life style through participation in exercising.

## P12S-05

**Effect of eccentric training on collagen synthesis rate in elite soccerplayers with chronic Achilles tendinosis**

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*Keywords: eccentric exercise, tendon, collagen*

It has been shown that carrying out a 12-week eccentric heavy resistance-training regime can cure runners suffering from chronic Achilles tendinosis. The mechanism behind the effectiveness of this treatment is unknown. The present study investigates the effect of an identical training regime on elite soccer players suffering from chronic Achilles tendinosis.

15 elite male soccer players (Superleague to 3. division) participated at the study. Nine of them suffered from tendinosis ( $27 \pm 1$  yrs) while 6 were healthy (control group,  $22 \pm 1$  yrs). All participants performed 12 weeks of heavy-resistance eccentric training, and continued playing soccer throughout the study. Before and after the training periods an array of physiological parameters was measured including collagen metabolism using microdialysis, mechanical tendon properties using ultrasonography, and Achilles tendon anatomical cross sectional area (CSA) using MRI.

The eccentric training resulted in subjective improvement and reduction in pain in the subjects suffering of a mild degree of tendinosis. After training an increased collagen synthesis was measured by microdialysis in the initially injured tendon (PICP: pre:  $3.9 \pm 2.5$  mg/l to post:  $19.7 \pm 5.4$  mg/l,  $p < 0.05$ ). The collagen synthesis was unchanged in healthy tendons (PICP: pre  $8.3 \pm 5.2$  mg/l to  $11.5 \pm 5.0$  mg/l,  $p > 0.05$ ). Collagen degradation measured as ICTP was not affected by training neither in the injured tendons nor in the healthy control group. CSA was 11 % smaller in injured tendons compared to the healthy control group. CSA increased in injured tendons with training, and injured tendons was found to be 4 % smaller post training than the healthy control group. Training did not increase CSA in healthy tendons. No changes were found in mechanical properties after training, neither in injured or in healthy tendons.

This study shows that chronically injured Achilles tendons have a smaller CSA compared to the healthy control group.

In addition, mechanical loading performed as eccentric training for 12 weeks affects chronic injured Achilles tendons by increasing collagen synthesis rate, and thereby diminishing the differences in CSA. The collagen metabolism in healthy control tendons seems not to be affected by eccentric training. These findings could indicate a relation between collagen metabolism and "healing" of injured tendons.

#### P12S-06

### Effect of aerobic dance on balance ability of middle aged women

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*Keywords: aerobic dance, balance control*

Therefore the aim of the study was to investigate the effect of regular aerobic dance, applied one or more years, on the static and dynamic balance of women in pre-, and postmenopausal period.

Fifty two physically inactive, healthy women (age: 48.6±5.1 years, body height: 162.7±5.4 cm, body weight: 67.5±11.4 kg) were recruited for the measurement. The sample was divided into three groups: postmenopausal women have been exercising for three years (GA), experimental (GE) and control (GC). Experimental groups have followed aerobic dance training for one year, three times per week, duration of one hour. For static and dynamic posturography, a special stabilometer was used. In Romberg the subjects stood on a sensor platform (50x50x12 cm) relaxed, erected position with open or closed eyes for 20 s while the excursion path of the center of pressure (COP) in latero-medial (A-M), anterior-posterior (A-P) directions was recorded. The length of the A-P, L-M and total (SUM) excursion path of COP were determined. At the dynamic balance test the subjects have to move the COP within a certain area (1 cm<sup>2</sup>) and color it. The area colored during 20 s in percent (A%) and the time spent within the area while coloring (t%) was determined.

No significant difference was observed between the experimental and control group either before or after one year exercising in any stabilometry measures. Both experimental and control group decreased the excursion distance of COP. Group A, exercising for three years, before measured, performed significantly shorter COP excursion than group E and group K, before experiment.

The GE and GK showed similar values before experiment in dynamic balance test. After one year of exercise GE coloured a significantly larger area (pre: 54.1±5.4%; post: 57.1±6.5%) than GC (pre: 52.4±5.4%; post: 52.0±8.8%). GE also improved in t% significantly (pre: 86.9±8.9%; post: 89.6±6.4%). GC did not improve (pre: 85.7±8.7%; post: 85.3±9.5%).

The result indicates that regular aerobic dance affects the dynamic postural control positively in middle-aged women, but it does not influence static balance.

#### P12S-07

### Relationship between body weight, BMI and motoric abilities in childhood

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*Keywords: obesity, motor abilities, children*

Obesity in childhood increases. The influence of nutrition and physical activity is indisputable. CHILT (=Children's Health Interventional Trial) is a prospective intervention for prevention at twelve primary schools. This abstract presents first results.

668 children (51.0% boys; 49.0% girls) were included at the beginning of their first year at school, their height and weight were measured, and BMI (kg/m<sup>2</sup>) was calculated. Endurance performance of the children was determined based on the 6-min run and coordination on the Koordinationstest für Kinder (KTK).

The children were 6.70±0.42 yrs. old, 122.72±5.36 cm tall and weighed 24.47±4.59 kg, their BMI was 16.17±2.27 kg/m<sup>2</sup>. KTK shows an average MQ of 93.49±15.01, the 6-minute run an average of 835.24 ± 110.87 m. Both tests showed a slight correlation between body weight (BW) and BMI, resp., and the result (KTK and BW r = -0.105 (p=0.020). KTK and BMI r = -0.164 (p<0.001); 6-minute run and BW r = -0.166 (p<0.001), 6-minute run and BMI r = -0.201 (p<0.001)); the overweight/obese children showed poorer results than normalweight/underweight ones (p<0.001 each). Summary: Even at this age, increased weight and BMI correlate negatively with coordination and endurance. To escape this vicious circle of lack of exercise, retardation/motoric deficiencies, increasing lack of exercise/malnutrition, early interdisciplinary intervention such as CHILT is necessary.

#### P12S-08

### Aerobic determinants of decline in preferred walking speed in healthy and active elderly subjects

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Hospital Arnaud de Villeneuve, France

*Keywords: gait, aging, ventilatory threshold*

The present study tested whether the decline in preferred walking speed in healthy elderly subjects is associated with higher fraction of ventilatory threshold at preferred walking speed.

We compared the preferred walking speed and the rate of VO<sub>2</sub> at preferred walking speed related to maximal oxygen uptake (VO<sub>2</sub>max) and to oxygen uptake corresponding to ventilatory threshold (TVE), in octogenarians (G80, n = 10) and in sexagenarians (G65, n = 10) walking on treadmill.

The preferred walking speed was lower in G80 (1.16 ± 0.09 m·s<sup>-1</sup>) than in G65 (1.38 ± 0.09 m·s<sup>-1</sup>; P < 0.001). The energy expenditure and the energy cost of walking at preferred walking speed were not significantly different between the two groups. The G80 subjects exhibited a significantly higher fraction of VO<sub>2</sub>max (60.75% ± 8.01) and fraction of TVE (74.22% ± 7.89) at preferred walking speed, when compared with G65 (42.92% ± 5.02 and 53.22% ± 5.71; P < 0.001). Multiple regression analysis showed that fraction of TVE, with a small contribution of height, was identified as the main determinant of the decline in preferred



walking speed in healthy and active elderly subjects ( $R^2 = 64\%$ ;  $P < 0.001$ ).

These findings suggest that the decline in preferred walking speed in octogenarians is associated to the increased fraction of TVE.

#### P12S-09

### Football participation improves physical fitness and bone mass in prepubescent boys

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*Keywords: physical fitness, bone mass, prepubescent children*

This study evaluated the effects of football participation on physical fitness and bone mass and how these variables related to each other in prepubescent boys, and was carried out according to the Helsinki Declaration.

One hundred and four prepubescent boys (Tanner<2), 53 footballers (3 hours per week) and 51 boys, whose physical activities were limited to those programmed during the compulsory physical education curriculum (control group), agreed to participate. Both groups had similar age ( $9.3 \pm 0.2$  and  $9.3 \pm 0.2$  years, mean  $\pm$  sem) and height. The maximal leg extension isometric force (MIF) in the squat position with knees bent at  $90^\circ$ , and the peak force (Fp), mean power (MP) and jump height (Hj) during countermovement (CMJ) and squat (SJ) jumps were measured with a force plate. Additionally, 30m run (T30), 300m run (AC), and 20m shuttles (MAP) were performed. Bone mineral content (BMC) and density (BMD) were also assessed (DXA). T test, ANCOVA (using height and body mass as covariates), multiple linear regression and bivariate correlations were applied for the statistical analysis.

The footballers attained better results in T30, AC, MAP and the Hj in the SJ ( $p < 0.05$ ). Greater BMC and BMD in the lower limbs (about 5-6%,  $p < 0.05$ ), as well as higher lumbar spine and pelvic BMD were found in the football players ( $p < 0.05$ ) than in the control group. Among all physical fitness variables, MIF showed the highest correlations with total and regional BMC and BMD. However, Fp and MP generated during SJ and CJ, and T30, also correlated with bone variables in all the scanned regions. Multiple regression analysis showed that the variables with the highest predictive value for whole body BMC (BMCT) in prepubescent boys are: body height, body mass and T30, as reflected the following equation:  $BMCT(g) = 13.6 \cdot \text{height}(cm) + 12.4 \cdot \text{Body mass}(g) - 109.2 \cdot T30(s) - 587$  ( $R = 0.92$ ,  $p < 0.001$ ).

In conclusion, football participation is associated with a significant improvement of physical fitness and bone mass in prepubescent boys. Moreover, there is a weak relationship between physical fitness and bone mass in prepubescent boys.

Haapasalo et al (1998). *J Bone Miner Res* 13(2): 310-319

Bass (2000). *Sports Med* 30(2): 73-78

#### P12S-10

### The use of two double maximal incremental exercise tests for baseline performance measures in moderately trained athletes

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*Keywords: performance, overtraining*

A decrease in performance, premature fatigue, and an increase in muscle soreness may characterise both overreached or overtrained athletes, with the difference that the first recover in a few days or weeks time span while the latter will recover in months and will degenerate into a more severe pathological state. However, reliable diagnostic markers for distinguishing between well-trained, overreached, and overtrained (OTS) athletes are lacking. We recently developed a "two exercise test" 1, to detect the subtle differences in performance and hormonal response in athletes with different (over)training status. In order to being able to validate baseline measures we examined the reproducibility of this "two exercise test". Performance and hormonal responses were measured in a group of moderately trained army recruits.

Subjects performed two graded incremental exercise tests to exhaustion on a cycle ergometer separated by 4 hours. Blood samples were collected before and after the first and the second exercise test. Blood samples were analysed for adrenocorticotrophic hormone, cortisol, growth hormone, prolactin. Performance was calculated as the seconds to perform the graded maximal exercise test. Performance was measured as the time to voluntary exhaustion. We compared the first and the second exercise tests in order to verify if the athletes were able to maintain the same performance.

Mean  $VO_{2max}$  was 53.34 ml/Kg/min (SD 6.70) in the first and 50.61 ml/Kg/min (SD 8.20) in the second exercise bout. Mean maximal lactate levels were 8.37 mmol/l (SD 1.92) in the first and 6.85 mmol/l (SD 1.65) in the second exercise bout. Mean performance measured as the time to perform the first test was 888.0 sec (SD 194.63) and for the second test 858.63 sec (SD 156.42). There was an 3.55 % decrease in  $VO_{2max}$  between the first and second test ( $P = 0.09$ ). There was an 15.97 % decrease in maximal lactate levels between the first versus the second test ( $P = 0.0002$ ). Performance in the second test decreased by 1.36 % versus the first test ( $P = 0.19$ ). The results indicate the reproducibility of performance and  $VO_{2max}$  measures when two max exercise bouts are used separated by 4 hours. The significant decrease in maximal lactate levels may be due to an incomplete resynthesis of muscle glycogen during recovery between the two exercise bouts. The main finding of this study is that the performance of a 2max test separated by 4 hours is reproduceable. This indicates that this test protocol is suitable for detecting subtle differences in training or overtraining status.

## P12S-11

**The effect of ultramarathon cycling on the heart rate in elite cyclists**

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*Keywords: intensity, heart rate, ultra-marathon cycling*

Man's heart rate (HR) response to ultramarathon cycling is poorly investigated (Neumayr 2003). With increasing popularity of ever-more grueling ultraendurance racing events a clear delineation of the exercise intensity, however, becomes essential for both an optimal competition preparation as well as a reliable estimation of cardiovascular demands and hazards involved. The aim of the study was to analyze the heart rate (HR) response and to estimate the ultraendurance threshold - the optimum maintainable exercise intensity of ultraendurance cycling - in ultraendurance elite cyclists competing in the "Race Across the Alps" (RATA).

HR monitoring was performed in 10 male world's best ultramarathon cyclists during the 1st RATA in 2001 (distance: 525 km; cumulative altitude difference: 12,600 m). HRs were recorded with an interval of 15 seconds during the whole marathon by the use of Polar Vantage NV telemeters (Polar Electro Oy, Finland). Four different exercise intensities were defined as percentages of maximal HR (HR<sub>max</sub>) as follows: recovery HR (HR<sub>re</sub>) < 70% of HR<sub>max</sub>; moderate aerobic HR (HR<sub>ma</sub>) = 70 - 80%; intense aerobic HR (HR<sub>ia</sub>) = 80 - 90%; and high-intensity HR (HR<sub>hi</sub>) > 90%.

All athletes investigated finished the competition. The mean racing time was 27h 25min, and the average speed was 18.6 km.h<sup>-1</sup>. The mean HR<sub>max</sub> was 186 b.min<sup>-1</sup>, and the average value of measured HRs (HR<sub>average</sub>) was 126 b.min<sup>-1</sup> resulting in a mean ratio HR<sub>average</sub>/HR<sub>max</sub> of 0.68 which is likely to correspond to the ultraendurance threshold. The athletes spent 53% (14h 32min) of total race time within HR<sub>re</sub>, 25% (6h 51min) within HR<sub>ma</sub>, 19% (5h 13min) within HR<sub>ia</sub>, and only 3% (49min) within HR<sub>hi</sub> which demonstrates exercise intensity to be predominantly moderate (HR<sub>re</sub> + HR<sub>ma</sub> = 78% or 21h 23min). The HR response was influenced by the course profile as well as by the duration. In all subjects exercise intensity declined significantly during the race - obvious by a decreasing ratio of HR<sub>average</sub>/HR<sub>max</sub> by 23% from 0.86 at the start to 0.66 at the end.

The interesting phenomenon of gradually decreasing HR during ultraendurance exercise speaks in favour of a certain down-regulation of the sympathetic system to protect the heart from serious damage. The cardiovascular response of ultramarathon cycling lasting for about 24 hours is characterized by a marked decline in the HR response (10%/10h) suggesting the ultraendurance threshold to lie just below 70% of HR<sub>max</sub>.

Neumayr G et al (2003). *Br J Sports Med*, in press

## P12S-12

**Muscular blood flow of hypertensive patients in water immersion**

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*Keywords: blood oxygen, immersion, hypertension*

We studied that subjects' heart rate at rest when immersed in water at 30-36 °C was lower than when they stood on the ground. Therefore we compared muscular blood flow kinetics

in and out of water in order to investigate the potential value of underwater exercises for elderly patients with hypertension.

After the sensor of a laser tissue blood-oxygen monitor was installed over the right vastus medialis muscle of 5 healthy aged subjects and aged hypertension patients who receive medical therapy, tissue oxygen saturation (StO<sub>2</sub>) level, tissue hemoglobin (HbT) level, tissue deoxygenated hemoglobin (HbD) level, and tissue oxygenated hemoglobin (HbO<sub>2</sub>) level were measured. Measurements were made for 6 conditions: standing, sitting, lying supine position on the ground, standing in water up to the navel or to the xiphoid positions and lying in supine position on the water.

Both, healthy subjects and those with hypertension, had the highest heart rate while standing on the ground, followed by sitting on the ground and lying supine on the ground. It was slightly higher while standing in water up to the navel position than when lying supine on the ground, and was the lowest while standing in water up to the xiphoid position. In healthy subjects and the hypertension patients, StO<sub>2</sub> level was the lowest while standing on the ground, followed by sitting on the ground and lying in supine position. It was slightly lower while standing in water up to the navel position than while lying supine on the ground, but was the highest when standing immersed to the xiphoid position.

The StO<sub>2</sub> level can be calculated from the ratio of tissue oxygenated hemoglobin level / tissue hemoglobin level. The StO<sub>2</sub> level appeared to increase due to the decrease in tissue hemoglobin level in femoral blood flow because the changes in posture or water pressure increased the venous return. Decreased heart rate increased the cardiac stroke volume due to increase in venous return, suggesting that both control group and hypertensive patients show the same reactions.

## P12S-13

**The role of PNF methods in the increase of hamstring flexibility to senior sportsmen**

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*Keywords: neuromuscular facilitation, hamstrings, stretching*

The acute changes of flexibility at senior athletes are produced by morphological changes of muscle. The aim of this study is to estimate the evolution of athletes using PNF methods in association with physical therapy, even if they are older.

In this study we have 20 senior athletes .The treatment included PNF methods (CR-PNF; HR-PNF, Kabat method and static stretch). We measured the amplitude of knee and shoulders and using Wilcoxon test and another scale of evaluation .We determined the values of Ao and Amx, of shoulder and knee, for minimal and maximal muscle and tissue stretching. We made an analysis of the evolution of flexibility in 0-7; 0-15; 0-21; 7-15; 7-21; days and 15 and 21days.

It is a good evolution from pretest to posttest. The increase was greater to treatment groups, with median differences of 1degree in the control group, 5degree -6degree to hold-relax and contract-relax PNF group, and 4degree in the static stretch group. A median difference exists between younger than age 65 but not aged 65 years or older.

One repetition (including stretching on 32seconds) provides an acute increase in flexibility of the hamstrings. Contract relax hold-relax and Kabat group produce a significantly improve flexibility. So, from people less than 65years this methods

represent more beneficial than static stretch. Also for women we observed an increase of flexibility even after 64years if we use these PNF methods.

#### P12S-14

### The effects of aerobic exercise training on glycemic control, cardio-respiratory fitness, and cardiovascular risk factors in Non-Insulin Dependent Diabetes Mellitus (NIDDM)

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*Keywords: aerobic exercise, cardiovascular risk factors, NIDDM*

Type II diabetes or NIDDM is highly related to obesity and inactivity. There is tremendous potential for improving and management of glycemic control, insulin sensitivity, and cardiovascular risk factors through increased physical activity in individuals with type II diabetes. We assessed the effect of an 8-week aerobic exercise program on cardiorespiratory fitness, plasma glucose and insulin concentration and the lipid profile in patients with NIDDM.

Twenty-four male subjects with type II diabetes (aged  $46.9 \pm 7.8$  yr; height  $165.2 \pm 5.5$  cm; weight  $73.5 \pm 12.2$  kg;  $VO_{2max}$   $40.3 \pm 6.5$  ml/kg/min; mean  $\pm$  SD) participated in this study. Subjects divided into high glycemic  $217.8 \pm 25.5$  mg/dl (HG, N = 12) and low glycemic  $149.9 \pm 20.2$  mg/dl (LG, N = 12) groups. After baseline measurements, exercise-training program that consisted of 45-60 min moderate-intensity (60-70% Max HR) cycling 3 times a week, carried out for 8-weeks.

For the 19 subjects finishing the study, maximal oxygen consumption ( $VO_{2max}$ ) increased significantly in both group ( $P < 0.05$ ). Blood glucose concentration reduced significantly in HG group ( $P < 0.05$ ) but this reduction was not statistically significant in LG group. Total, low-density lipoprotein (LDL) cholesterol, and triglyceride levels did not change significantly after exercise program in both groups. High-density lipoprotein (HDL) increased in the HG group ( $P < 0.05$ ) but not in the LG group. Body weight, body mass index (BMI), percent body fat decreased significantly in both groups ( $P < 0.05$ ). Comparing the relative changes in physiological parameters shows there were no significant differences between the two groups.

The 8-week exercise training program improved the glycemic control, lipid profile, cardio-respiratory fitness, and body composition of type II diabetic men. The most favorable changes were in patients with high glycemic.

#### P12S-15

### The effects of resistance training on physical capacities in Greek adolescent soccer players

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*Keywords: soccer, resistance strength training, adolescents*

The purpose of this study was to investigate the effect of a progressive weight-training program on physical capacities of 12-15 years old soccer players. Twenty six adolescents who were at level »4 according to Tanner's scale divided into 3 groups: weight training (n=9), soccer training (n=9) and control (n=8). Both training groups weight and soccer (age:  $13.9 \pm 0.7$  yr., body mass:  $53.2 \pm 10$  kg, height:  $163 \pm 9.5$  cm,  $VO_{2max}$ :  $46.2 \pm 4.3$  ml/kg/min) followed a soccer training program. The weight group followed an additional resistance training program twice a week for 16 weeks, which included the exercises: leg press, bench press, leg extension, lat pull-downs, leg flexion, peck-deck, and overhead press. At each exercise 2-3 sets of 8-15 rep. were performed with 2-3 min of rest between sets and 3-5 min between exercises. The intensity used was 55% of the one repetition maximum (1-RM) at the beginning of the program and progressively increased to 80% of the 1-RM during the course of the study. Flexibility (sit and reach), maximal strength (1-RM) of leg press and bench press, countermovement (CMJ) and squat jump (SJ) height, anaerobic capacity (average height of repeated jumps for 30 sec), speed (10m and 30m sprint time) and agility (10X5m) were measured before, after 8 weeks and after 16 weeks of training. A two-way ANCOVA (with the initial values as a covariate) was used to test the differences between groups. The weight group presented higher values ( $p < 0.01$ ) than the soccer group and the control group in leg press and bench press exercises as well in the CMJ and the SJ height ( $p < 0.05$ ). The weight group yielded better results than the control group in 30m-sprint time ( $p < 0.05$ ). The soccer group differed from the control only in the maximal strength of leg press ( $p < 0.05$ ). Both training groups had higher ( $p < 0.05$ ) agility scores than the control group. No differences were observed between groups in flexibility, 10m-sprint time and anaerobic capacity. These results show that weight training in addition to soccer training have a positive effect in maximal strength, vertical jump performance and 30m-sprint time in adolescent boys.

## Poster Session

## Health and Fitness 6

## P12T

## P12T-01

**Effects of dumbbell exercise training on plasma lipoprotein profiles in elderly women with elevated ratio of total cholesterol/HDL-cholesterol**

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**Keywords:** resistance strength training, dumbbell exercise, lipoprotein profiles

Previous studies have demonstrated that endurance training improved blood lipoprotein profiles in the elderly (Paillard et al. 2002); however, the effects of resistance training (RT) on blood lipoprotein profiles in the elderly are not well documented. Furthermore, to our knowledge there are no studies that examine the differences in the responses of RT on the plasma lipoprotein profiles with different levels of T-C/HDL-C. The purpose of this study was to compare the effects of RT on the plasma lipoprotein profiles in elderly women with the normal and the high ratio of T-C/HDL-C.

Sixty untrained elderly women ages 60-75 years volunteered as the subjects. All subjects were divided into following four groups (15 for each group): normal ratio (T-C/HDL-C<4.0) control (NC), normal ratio training (NT), high ratio (4.0≤T-C/HDL-C) control (HC), and high ratio training (HT) group. Training groups performed the fourteen kinds of dumbbell exercise (two sets, 15-20 repetitions, 1kg weight) 4 times a week for 12 weeks. The resting venous blood samples were obtained to determine plasma T-C, HDL-C, triglyceride (TG) concentrations before and after the experimental session.

The RT tended to decrease blood pressure, and a significant decrease was found in systolic blood pressure (SBP) for the NT group ( $p<0.05$ ), and in diastolic blood pressure (DBP) for the HT group ( $p<0.05$ ), respectively. The RT decreased the plasma T-C/HDL-C ratio ( $p<0.01$ ) and TG concentrations ( $p<0.05$ ) in the HT group compared with the levels before the training session; however, no significant changes were observed for any plasma lipoprotein profiles for the other three groups. Thus, the T-C/HDL-C ratio in the HT group after the experimental session was significantly lower than in the HC group ( $p<0.01$ ). Although changes in the plasma T-C concentrations in the HT group were also favourable as compared to the other three groups, no significant changes were noted for the plasma T-C and HDL-C concentrations for any groups.

These results suggest that the dumbbell exercise training for 12 weeks decreased blood pressure in the elderly women, and improved blood lipoprotein profiles in the elderly women with the high ratio of T-C/HDL-C.

Paillard et al. (2002). *J Nutr Health Aging* 6: 138-40

## P12T-02

**Physical fitness assessment of leg muscle strength and tapping rhythm for aged people**

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**Keywords:** leg strength, elderly, central motor function

We measured leg extension strength (LES), 30-s chair stand (CS-30) test and a tapping test, and examined the levels of ability that aged persons should keep for their quality of life.

Subjects were 101 healthy persons (72 females, 29 males, aged 12-78 years). The score of CS-30 test was the number of motions which subjects stand up and sit down on a chair of height 40 cm for 30 seconds. In the tapping test subjects tapped plastic board on which paper strain gauge was attached with hearing 4 Hz signals for 90 seconds to obtain over 300 points data for FFT (Fast Fourier Transform) analysis. The sampling rate was 1 kHz. The spectral analysis was performed and the divided three areas were calculated between 0.05-0.20 Hz (A1), 0.20-0.35 Hz (A2), and 0.35-0.50 Hz (A3).

The right and left LES per body weight (LES/wt) were 0.43 (0.12, SD) and 0.41 (0.15) kg/kg, respectively. The both LES/wt of young subjects were over 0.35 kg/kg, and that of 33 subjects over 40 years were over 0.30 kg/kg, however 6 subjects showed less than 0.30 kg/kg. The score of CS-30 test was 20.7 (6.2) times, and that of 2 persons were less than 10 times. There was a significant positive relationship between LES/wt and CS-30 test. There is no difference among the parameters of tapping rhythm and among the areas between young and aged subjects. The mean tapping rhythm was 3.96 (0.08) Hz ( $n=101$ ), and that of most subjects were between 3.80 and 4.05 Hz, however, three subjects (48, 52, 67 yr) showed higher values, which were 4.30, 4.22, 4.61 Hz. The coefficient of variation (CV) of the tapping was 6.12 (1.87) %. The values of total area (0.05-0.50Hz) and divided three areas (A1, A2, A3) of spectrum were 31.2 (12.9), 5.2 (2.6), 12.3 (4.6), 13.7 (7.3) s<sup>2</sup>, respectively. There were significant correlations among the CV, total area, A1, A2, and A3.

The LESs /wt of young persons were over 0.35 kg/kg, and that of 85% of over 40 years persons were 0.30kg/kg. This data suggested that LES/wt might be needed over 30% of body weight. Likely CS-30 test might recommend over 15 times for maintaining useful life. Tapping rhythm showed no difference between young and aged persons. Taping rhythm was a parameter related to function of basal ganglia, and it was no good parameter for assessing an aging effect of central motor function. In conclusion, we showed the minimum levels of LES/wt and CS-30 test for aged persons to keep QOL. It might be 0.30 kg/kg and 15 times, respectively.

## P12T-03

**Teacher and athletes physiological characterization in intermediate aerobic classes****Baptista Alves José, Vences Brito António**

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*Keywords: lactate, heart rate, aerobics*

The aim of this study is to know if the aerobic teachers, when giving a class, have the physiological profile that characterizes this activity, and simultaneously compare it to the physiological profile of the athletes.

A sample of twenty individuals, 10 teachers and 10 athletes, belonging to the teachers' classes, performed an aerobics class. The variables being studied were heartbeat frequency (HBF) and Lactate (LAC), both of which were estimated by was made using a heartbeat frequency measurement Polar Vantage NV Work and a blood portable analyser. To estimate the HBF a constant register was made, and LAC was estimated from gathering blood samples at six different times. The following statistical techniques were applied: T Student, T Pares, and Pearson's Moment. The degree of significance adopted was  $p < 0.05$ .

In relation to the teachers HBF they performed the class with an average of 60.5, + 9.38% HBF max, where the lowest register was of 46.58% and the highest was of 70.82%. The athletes showed an average of 60.3, + 5.8 HBF max, with registers between 52.66% and 66.66%. No significative differences were found between the groups.

From the minute 15 to the minute 25, there's a significative difference of the HBF (  $p = 0.000$  ). In relation to LAC the teachers showed an average of 1.95 + 0.59 mmol.l-1.

In relation to the athletes the average LAC was 2.32 + 0.60 mmol.l-1. Significant differences were observed between the groups when testing the LAC at minute 50 ( $p = 0.011$ ). Significant differences were also observed in the LAC results between minute 15 and 25, ( $p = 0.037$ ). In relation to the time of practice there only exists an inter-connexion of the LAC results at minute 50 ( $p = 0.011$ ).

Both teachers and athletes show a physiological profile, which is characteristic of the aerobics activity. The only difference observed was the one between the LAC results at minute 50. Concerning the results of HBF and their LAC during the period of highest intensity minute 15 to 25 showed significative differences especially the HBF. The inter-connexion between the time of practice and the withdrawn results were only observed in LAC at minute 50.

## P12T-04

**Health-related endurance training with table tennis****Pfeifer Klaus, Heinz Barb, Soehngen Marcus**

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*Keywords: endurance, table tennis*

Racket sports are seen rather inappropriate for health-related sports activities. The present study evaluates an endurance-oriented table tennis program for beginners.

6 women and 2 men ( $35.12 \pm 5.2$  years ( $32 - 47$ )) participated 2x/week in a health-oriented table tennis program over a period of 5 weeks. The exercise sessions ( $ES=90'$ ) focused on 30 min. endurance part (EP) consisting of tabletennis specific exercises. The participants controlled their exercise intensities via heart rate monitors. The EP, prepared by a warm-up phase, faded to a game part and a

gymnastics part, the ES ended with a relaxation phase. The aerobic endurance was tested by the 2km-Walking Test before and after the program. The heart rates (HR) of each participant of the whole ES were sampled to analyse the intensity structure. To determine individual physical strain, blood lactate concentrations were determined during the EP of every week's first ES. Additionally, the rate of perceived exertions (RPE) was measured.

The Walking-Test showed improvements ( $p < .001$ ) of walking time ( $15.4 \pm 0.8$  min vs.  $16.7 \pm 0.8$  min), estimated  $VO_{2max}$  ( $38.1 \pm 3.5$  vs.  $34.4 \pm 0.4$  ml/min/kg) and Fitness Index ( $101.5 \pm 7.2$  vs.  $91.3 \pm 8.5$ ). During the EP participants showed constant HR (CV: 3.2 - 6.4%) with max.  $12.3 \pm 1.9\%$  deviation from individually calculated exercise-HR with lactate values lower than 2 mmol/l. Participants reported RPE-values of 11-14.

The choice of specific exercise together with the teaching of knowledge to control training intensity enables an individualized health-related endurance training with table tennis.

## P12T-05

**Lifestyle and physical activity of older adults in Northeast Asia****Tsutomu Suda, Hideki Asao, Isao Morita, Shidlovsky George, Dong Qin Guang**

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*Keywords: physical activity, elderly*

Residents in cold regions tend to be inactive during winter. In contrast to the facts that a large proportion of the Canadian (Shephard et al, 1978) and Finnish populations (Vuolle et al, 1986) maintain a physically active way of life, most of people in Northeast Asia are supposed to remain inactive during winter. Moreover, physical inactivity sometimes relate with other unhealthy lifestyle such as obesity or smoking. These problems will be more serious for the elderly since the physical inactivity or unhealthy lifestyle are thought to be causes of high medical expenditure or financial burden for support of dependent life. Nevertheless, no information was presented regarding on the lifestyle and physical activity of the population in Northeast Asia. This study was designed to elucidate the relationship between lifestyle and physical activity of the elderly living in Northeast Asia. Questionnaires that included questions on self-reported health status, tobacco and alcohol consumption, physical activity during snow-free seasons and snowfall seasons, and social activity were distributed to free-living elderly in Hokkaido (Japan), Sakhalin (Russia) and Harbin (China) for the purpose to elucidate the lifestyles and physical activity of older adults in cold regions of Northeast Asia. The sample population obtained from the survey consisted of 849 (346 males, 65-95, 74.6 years and 503 females, 65-91, 74.8 years) in Hokkaido (Japan), 544 (244 males, 60-83, 67.3 years and 300 females, 60-91, 67.4 years) Sakhalin (Russia) and 498 (239 males, 60-96, 70.7 years and 259 females, 60-93, 70.4 years) in Harbin (China).

Walking was the most popular exercise among the populations in three regions. In all group of regions, regular exerciser decreased markedly during winter both males and females. That is to say, percentages of regular exercisers in males and females who practice exercise more than 3 times per week from snow-free seasons to snowfall seasons were 54.% vs 38% and 46% vs 27% in Hokkaido, 38% vs 28% and 28% vs 19% in Sakhalin, and 69% vs 46% and 56% vs 38% in Harbin, respectively. As found by Cockerham (1997) for Russian, also in this study an unhealthy lifestyle was found

for elderly in Sakhalin, characterized by the higher rate in male smoker, overweight and obesity, and lower rate in regular exercisers relating with short life expectancy and high mortality rate by coronary heart diseases.

Older adult population in Northeast Asia are facing a common task to improve lifestyle, that is to say, decreasing smoking, and being physically active during cold winter.

#### P12T-06

### Can exercise intervention affect life quality in already active obese adults?

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**Keywords:** obesity, quality of life

In October 1999 the Salzburg Obesity Academy Foundation in cooperation with the University of Salzburg started an interdisciplinary 5-year lasting weight management program. Based on behavioural therapy psychologists, sport scientists, dieticians and bariatric surgeons work together in treating aetiology factors of obesity. Quality of life (QoL) as defined by the WHO (1994) is the individual perception of a person according to their position in life based on culture and values. In overweight people QoL is significantly reduced when compared to normal weight. Experimental trials support the positive effect of moderate exercise on psychological well-being (Biddle and Mutrie 2001). How physical fitness affects QoL of obese people is not well documented. So the purpose of our study is to investigate the effect of a 4-month lasting exercise intervention on QoL and if physical fitness is related to QoL especially in already active obese adults.

Change in quality of life was measured in 12 obese adults (50.2±9.6yr, 90.5 ±9.1kg, 34.1±3.5BMI, 41.7±6.3% fat, 32.6±7.7 ml min<sup>-1</sup> kg<sup>-1</sup>) who participated in the programme. The here used 10pt-scale Moorhead-Ardelt questionnaire consists of 5 QoL-domains as well-being, physical activity, social contacts, occupational and sexual contentment (Ardelt-Gattinger et al. 2000). The physical fitness test protocol, based on the health-related fitness test battery of Suni et al. (1996), contains cardio-respiratory fitness (CRF, VO<sub>2</sub>peak, Fitness Index FI), muscle performance (peak isometric force PIF of right and left leg) and motor fitness (MF, balance, one-leg stand with closed eyes right and left). The exercise program was completed 2x90min/week (21 lessons, 79min netto exercising time) containing 23% motor skill tasks, 22% endurance tasks, 17% games, 14% strength tasks and 12% stretching or recreation. T-test for paired samples (parametric or non-parametric) and correlation analysis (Pearson or Spearman) were used to analyze the impact of physical fitness on QoL. Correlation was completed by calculating the individual difference (post - pre) of each variable.

According to the 4-month exercise intervention no significant changes were found in the QoL-items (item1 "well-being", Z=-1.732, p=.083). Pre to post differences were found between VO<sub>2</sub>peak (T=2.363, p=.038), in FI (T=-2.583, p=.027), in PIF right leg (T=-2.662, p=.022) and in balance (right T=2.379, p=.037 and left T=2.231, p=.047).

PIF-right was correlated with the QoL-item1 "well-being" (r=.68) and with item3 "social life" (r=.66). Balance was correlated too to item 4 (r=-.77) and 5 (r=-.73). Pmax was correlated to item 5 (r=-.79).

This study showed that the here presented exercise intervention increased mobility and that an enhancement in mobility will alter quality of life positively in already active obese adults.

Ardelt-Gattinger E. et al. (2000). In: E. Hell / K. Miller (eds.), p.172-193.

Biddle and Mutrie (2001). Routledge, London, p.167-201.

Suni et al. (1996). Arch Phys. Med. Rehabil. 77, p.399-404.

#### P12T-07

### Cold-related disorders in conscripts: Associations with the level of physical activity, fitness and BMI

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**Keywords:** exercise, vasoconstriction, environment

The occurrence of cold-related disorders and their associations with the level of physical activity, aerobic fitness, and body composition were studied in 7153 male conscripts. The mean age was 18.8 years. In the beginning of the military education they answered on questions about cold-associated disorders, subjective sensitivity for cold and physical activity. Body mass index (BMI) and aerobic fitness (Cooper's 12-minute running test) were measured during the first weeks of military education. The differences in the occurrence of cold disorders between the groups formed according to the level of physical activity, aerobic fitness and BMI were analysed by chi-square-test.

From the conscripts 15 % reported poor adaptation for cold, 14 % had unusual finger sensitivity for cold, 12 % had paroxysmal color change of fingers in cold, 7 % had cold-induced headache, 6 % cold-induced visual disturbances and 13 % cold-induced chest pain.

Percieved poor adaptation for cold environment was associated with poor aerobic fitness, low level of physical activity, and underweight (BMI< 20.0), p<0.001. Paroxysmal color change in fingers and migraena in cold were associated with underweight, p<0.001. Chest pain and migraena in cold were associated with poor aerobic fitness, p<0.001. Cold-induced visual disturbances had no associations with the level of physical activity, aerobic fitness or BMI.

The results indicate that a remarkable proportion of conscripts have cold-related disorders, which may cause health problems. Underweight, poor aerobic fitness and a low level of physical activity were associated with a higher prevalence of cold-related disorders.

#### P12T-08

### Level of motor abilities as a predictor of future performance in tennis - study of Junior Grand Slam winners

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**Keywords:** motor abilities, tennis, junior athletes

Results of many researches (Schönborn 1984, Elliott et al 1989, Muller 1989) define motor abilities of dynamic character like speed, agility and power play as extremely important components of tennis players' performance. Additionally some authors (Schönborn 1994, Unierzyski 1996, Unierzyski, Osinski 1998) expressed that aspiring young tennis players should have all-important abilities on a good (average or better) level already at the young age. Unfortunately, until now there was no international research undertaken with the same methods for players coming from different countries. Therefore, the aim of the project was to

find out if the level of motor abilities was behind progress done by most successful young players.

The studies were conducted between 1994 and 1999 during various European tournaments for 13/14 old tennis players. Over 600 girls and boys from 57 countries underwent a simple battery of motor ability tests. Results of 8 players (4 girls and 4 boys) were taken for the analysis. Each of the players tested at the age of 13 or 14 has won at least one of the Junior Grand Slam tournaments 2-4 years after the moment of research. Standardisation was used to compare the results reached by players of different age and gender. The 'mean' profile was calculated from standardised 'single' results of all athletes.

The results show that all investigated players reached average or better (i.e.  $\pm 0.5$  of standard deviation) results in all motor ability tests. Non of the investigated players has reached poor (i.e. below -1 SD) results in any of the tests.

This confirms the results of Schönborn (1984), Elliott et al (1989, 1990) and Muller (1989)), who pointed the importance of motor abilities, especially agility, as predictors of future performance in tennis. It is also confirmed that talented player ought to have 'dynamic' abilities for a good (e.g. around average or better) level.

Elliott BC et al (1989). Australian Journal of Science and Medicine in Sport, 21(3)2; Müller E (1989) Sportmotorische Testverfahren zur Talentausswahl im Tennis. Leistungssport no 2; Schönborn R. (1984). Talentsuche und Talentförderung im Tennis. Unierzyski P, Osinski W. (1998) Factors affecting performance in tennis (in Polish) AWF Poznan; Unierzyski P (1996) A retrospective analysis of junior grand slam winners. ITF Sport Science and Coaches Review, Issue 9.p 2.

#### P12T-09

### The influence of different types of physical exercise on depression and anxiety scores in obese adolescents

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**Keywords:** obesity, adolescents, depression

The anxiety and the depression, can make the hypocinesis and consequently to a decrease in the daily energy expenditure, favoring the appearance of the obesity in adolescents. The aim of the present study was to investigate the possible influence of different types of physical exercise, as an alternative treatment in the indicative scores of depression and anxiety in female adolescents with severe obesity.

40 adolescents with severe obesity (IBM  $\geq$  95th percentile), with ages from 14 to 19 years ( $16 \pm 1.56$ ), and divided into 4 groups: a) aerobic exercise group (n=10); b) anaerobic exercise group (n=10); c) leisure activity group (n=10) and d) control group (n=10). The adolescents executed 3 times weekly of exercises, for 3 months.

The results revealed that the aerobic training group obtained a significant decrease of the scores for depression, and in the control group a significant decrease of the anxiety scores. All the groups that executed physical exercise obtained an improvement of the physical conditioning.

The data suggest that the aerobic physical exercise, executed on a cycle ergometer with the intensity of the ventilatory anaerobic threshold, can be an interesting therapeutic option for the treatment of the depression, decreasing significantly the scores of this psychological disturbance, in female obese adolescents.

#### P12T-10

### Lack of physical activity as a determinant factor of overweight and obesity incidence rates in school age children

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**Keywords:** obesity, epidemiology, overweight

Actually, the obesity can be considered a world epidemiology with multifactor causes such as: the excess of caloric input; the lack of physical activity; the heredity; the environment; life styles and finally the pathological causes. The lack of physical activity represents a common characteristic to the majority of school age children, with high incidence rates of overweight and obesity. In that way, the main purpose of this research was to evaluate the determinant socio-cultural factors, mainly related to physical activity participation, of overweight and obesity incidence rates in a representative sample constituted by school age children aged from 6 to 10 years old.

For this study, 870 children aged from 6 to 10 years old (451 males and 409 females) were analysed. The chosen criterion variables were the Body Mass Index (BMI) as an absolute index and the incidence rate of overweight and obesity related to age and gender, based on the cut off points proposed by Cole et al. (2000)<sup>1</sup>. Physical activity data was measured with a validated questionnaire. In order to verify the interaction between the categorical variables and the independent variables the contingency table (X<sup>2</sup>) and the PHI coefficient (P), was applied. We can observe that almost 26% of our representative sample of Portuguese Northeast children from 6 up to 10 years old has general overweight. When we take the gender into consideration, we can also observe that the female children have more propensities to overweight than male children. Similar results were observed in the consulted literature (Cole et al., 2000). Our results pointed out, also, that all types of practice (from global practice to formal practice) were negatively correlated with the incidence rate of overweight, obesity and overweight plus obesity.

This negative interaction between the criterion and all types of practice allowed us to conclude that: (I) the young children's physical activity participation is a very important factor to prevent the appearance of overweight and /or obesity; (II) intensive physical activity participation (especially by the combination of the formal practice in club plus school programs) is the best solution to prevent obesity and overweight.

Cole T et al. (2000). *British Medical Journal*, 320, 1-6.

#### P12T-11

### Relationship between body composition and performance in popular marathon runners

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**Keywords:** body composition, anthropometry, marathon

Usually the fitness of the popular marathon runners is not the appropriate for affording a so stressful effort like the marathon. In order to promote the healthy practice of the marathon, the organisers of the Popular Marathon of Madrid (MAPOMA) are carrying out a project for novice runners. Participants enrolled on this project follow a three months training program adapted to their level under the supervision of a team of professionals which includes coaches and

monitors, sport physicians, physiotherapists, podiatrists, psychologists, nutritionists and other professionals related with the sport science. As a part of the examination, an anthropometric survey was made with the aim of providing the most comprehensive information to coaches and athletes. Parts of the data of this study are analysed in this work.

A sample of 43 male novice athletes (aged 39,2) involved in the official training program of the MAPOMA were measured in order to obtain somatotype, sum of 4 and 6 skinfolds, and body composition. Calibrated and validated instruments (Holtain skinfold caliper, GPM slading caliper, Rowenta digital weight scale and Holtain anthropometer) were used, and ISAK standardised protocols were followed. Correlations between the athlete's performance and different variable were calculated.

Average values of the sum of six skinfolds were 106,2 mm, and 63,6 mm for four skinfolds. The body fat was 13,9%. Considering the independent skinfolds values, all of them shows significant differences with values between  $r = 0,40$  ( $p < 0,05$ ) for the medial calf skinfold and  $r = 0,61$  ( $p < 0,001$ ) for the abdominal skinfold. The somatotype of the sample were (4,5 - 5,1 - 1,6)

In figure 1, it can be seen that the endomorphic component of the popular Spanish marathon runners is much higher than the elite Spanish marathon runners, but mesomorphic component is similar and ectomorphy is smaller. In most of the cases the physique of the popular runner is clearly endomorphic and overweighted.

Values of body fat of the sample can be considered normal for sedentary men but they are far away from normal values for distance runners (i.e. 5,8% of body fat and sum of six skinfolds = 30 mm, in Olympic athletes; Carter, 1982). The performance in marathon is directly related with their physique, especially with the amount of body fat, in low level competition.

<http://www.carreraspopulares.com/maratonmadrid/2002-entrenamiento.htm>

## P12T-12

### Comparison of physical activity level between falling and not-falling elderly men

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*Keywords: physical activity, elderly, falls*

The main aim of the study was to compare physical activity (PA) level between falling and non-falling elderly men.

138 elderly men (mean value  $72.6 \pm 5.85$  years) were examined. Subjects were divided into 3 groups (Cambell et al, 1981): N - non-fallers ( $n=96$ ), FID - fallers by internal disorders reasons ( $n=25$ ) and FEC - fallers by external circumstances reasons ( $n=17$ ). The Caltrac accelerometer (Muscle Dynamics, Inc., Torrance, CA) was used to estimate one - week energy expenditure. The measurement included total energy expenditure (TEE), resting energy expenditure (REE) and energy expenditure related to PA (PA-EE). In each group of subjects average one-day TEE, REE and PA-EE were calculated. PA-EE values were also counted per kg of body mass.

Obtained results (mean and standard deviation) of energy expenditure characteristics in groups N, FID and FEC were assumed respectively: TEE [kcal/day] -  $2042.85 \pm 250.612$ ,  $2019.05 \pm 223.158$ ,  $1909.45 \pm 288.501$ , REE [kcal/day] -  $1736.61 \pm 182.798$ ,  $1790.57 \pm 164.867$ ,  $1601.73 \pm 186.014$ , PA-EE [kcal/day] -  $306.24 \pm 145.805$ ,  $228.48 \pm 108.655$ ,

$307.71 \pm 135.662$ , PA-EE [kcal/day/kg] -  $3.82 \pm 1.770$ ,  $2.64 \pm 1.167$ ,  $4.29 \pm 1.696$ .

There were no statistically significant differences in TEE between groups. Statistically significant ( $p < 0.01$ ) lower value of REE was observed in FEC in comparison to other groups.

The differences in PA-EE between groups N and FEC were statistically not significant in mean values of one-day energy expenditure and also in values calculated per day and kg of body mass. FID group obtained the lowest values of PA-EE. The statistically significant difference ( $p < 0.05$ ) in one-day PA-EE was observed only between groups FID and N. In comparison of one-day PA-EE calculated per kg of body mass statistically significant differences ( $p < 0.01$ ) were noticed between FID group and both other groups.

#### Discussion/Conclusion

Obtain results indicated, that lower level of PA is connected with higher risk of fall among elderly men. It is worth considering that falling persons can avoid PA because of fear of next falls.

*Cambell AJet al, (1981), Falls in old age: a study of frequency and related clinical factors. Age and Ageing, 10: 264 – 270*

## P12T-13

### The effects of low intensity exercise for EEG

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*Keywords: low intensity exercise, EEG, spectral analysis*

It has been reported that physical exercise influences metabolic and affective states in individual fatigue. And the American College of Sports Medicine and the Centers for Disease Control and Prevention (ACSM-CDC) developed a physical activity recommendation geared toward getting more people active. Moreover, it was shown from the ACSM in recent years that a physical activity of a level lower than time and intensity of the exercise, which have so far been recommended, also has the contribution to health. This study was designed to examine the changes in electroencephalography (EEG) after low intensity acute exercise below ventilatory threshold (VT) level.

Eleven healthy males, mean age 22.0 (SD 1.48) years, were examined under the VT level for 20 minutes after the submaximal exercise pretest to determine the VT level. EEG, electrocardiogram (ECG), respiratory curve and eye movement measurements were performed for 15 minutes before and after the experimental state. The EEG signals were recorded from Cz, Pz, O1 and O2 (10-20 system) and the ECG signals were also recorded throughout the experiment state. Spectral analysis using the maximum entropy method (MEM) for the EEG was applied for 5 minutes just before (pre) and after (post) experimental condition. Post/pre ratios were calculated, after the power spectral density (PSD) and relative percentage for total spectral power (relative time percent: Time%) of delta (0.5-4Hz), theta (4-8Hz), alpha 1 (low alpha: 8-11Hz), alpha 2 (high alpha: 11-14Hz), beta 1 (low beta: 14-20Hz), beta 2 (high beta: 20-30Hz) and total waves (0.5-30Hz) in EEG were analysed.

In the low intensity acute exercise, total and low alpha wave band of PSD were increased same as high intensity exercise. It has been recognized that change of a beta wave band has a difference by the placement from the reason that beta wave band of Time% was increased at Cz, and decreased at O1 and O2. Alpha PSD at O1 and O2 were higher than the other placements.

These results suggest that the constitution of EEG frequency bands were changed not only after high intensity acute



exercise but also after low intensity acute exercise. It was suggested that it is necessary to consider the difference by the EEG placement to evaluate for the change in the rate of a beta wave band and not only an alpha wave, but the necessity for the examination about the appearance of a beta wave was considered.

#### P12T-14

### Effects of light resistance training on aerobic capacity and muscle strength in elderly people

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*Keywords: elderly, health promotion, resistance strength training*

The purpose of the present study was to assess the effects of 4-months light resistance training on aerobic work capacity and muscle strength in 15 elderly people (6 males and 9 females aged 58-76 years old) who were responding to the request of Takizawa In-Home Care Support Centre.

Training was instructed and performed once a week by using a rubber band with a flexibility level chosen for each individual. Hip joint flexion, knee extension, leg abduction, shoulder extension, arm push, elbow flexion, rowing, sit up and standing up from a chair were repeated 10 to 20 times each. Additionally, it was recommended that the training program be performed 2-3 times per week at home. To encourage the subjects to continue training, various recreational activities (dancing, walking, table tennis and badminton) were offered once a month. Before and after training period (4 months), maximal oxygen uptake (VO<sub>2</sub>max: questionnaire method), maximum isometric and isokinetic (180 deg/sec) torques during knee extension and flexion (dynamometer) were measured.

Estimated VO<sub>2</sub>max was not altered (28.7 ± 2.9 ml/min/kg: before, 29.5 ± 3.3 ml/min/kg: after for males, 19.3 ± 2.8 ml/min/kg: before, 20.2 ± 2.0 ml/min/kg: after for females). Training resulted in a 19.8 % and 121.1 % increase in maximum isokinetic torques, for females during knee extension ( $P < 0.05$ ) and for males during flexion ( $P < 0.05$ ). For maximum isokinetic torques, there was no difference between males and females before training. However, the values for males were greater than that for females after training. The present study showed that light resistance training using a rubber band was effective for improving the maximum isokinetic strength in elderly people, and the effects on muscle strength were greater for males than for females. However, the training method could not increase maximum isometric torques. Insufficient intensity and/or amount of exercise might have caused the ineffectiveness in increasing static strength. However, it is considered that improving dynamic muscle strength is a more useful contribution to mobility in daily life. It was demonstrated that light resistance training did not improve aerobic capacity.

Therefore, multicomponent training including resistance and endurance exercise would be more valid for total fitness in elderly people.

#### P12T-15

### Effects of cardiovascular exercise, resistance exercise and rest on mood over time

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*Keywords: resistance exercise, cardiovascular exercise, mood*

Much research is currently available suggesting that acute exercise can result in an increase in positive mood and a decrease in negative mood. Much of this research however, has been conducted using a combination of cardiovascular and resistance exercises. This study compared the effects on mood of acute cardiovascular exercise and acute resistance exercise, over the three hours following exercise.

Twenty lean, regular exercisers (10 males, 10 females) undertook cardiovascular exercise, resistance exercise and rest for 30 min. on three separate occasions. Cardiovascular exercise was undertaken on a treadmill at an intensity of 60% estimated VO<sub>2</sub> max. Resistance exercise was undertaken on a variety of resistance machines requiring completion of 20 repetitions of each exercise at an intensity of 60% maximum effort. Rest was undertaken by sitting and reading at the side of the exercise area. Mood was measured before, immediately after, and 30 min., 60 min., 120 min., and 180min. after exercise, using the State Trait Anxiety Inventory (STAI), the Profile and Mood States (POMS) and the Positive and Negative Affect Scale (PANAS).

Significant effects of mood (smallest  $F(1,18)=76.37$ ,  $p<0.01$ ), time by mood (smallest  $F(5,90)=2.49$ ,  $p=0.04$ ), and condition by time by mood (smallest  $F(10,80)=2.04$ ,  $p=0.03$ ) were found in all three scales. Positive mood was significantly greater than negative mood. Positive mood was found to increase (STAI, POMS) or remain the same (PANAS) over the three hour measurement period, and negative mood was found to decrease. Positive mood was also found to increase to the greatest extent over the cardiovascular exercise, compared to the resistance exercise, and compared to the rest in the STAI and POMS. Positive mood in the PANAS was found to decrease to the least extent over the cardiovascular exercise > resistance exercise > rest. Negative mood was found to decrease to the greatest extent over the cardiovascular exercise > resistance exercise > rest (STAI, POMS, PANAS).

The findings of this study confirm the findings of previous studies that acute exercise can have effects on mood, where exercise can result in an increase in positive mood and a decrease in negative mood. The findings of this study however, also suggest that these effects are maintained over the three hours following exercise, and that these effects are greater following cardiovascular exercise compared to following resistance exercise.

## Poster Session

## Health and Fitness 7

P12U

## P12U-01

**Relationships among physical fitness, sex and body composition in primary school children****Christodoulos Antonios**

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*Keywords: physical fitness, obesity, childhood*

Obesity has negative effects on aerobic fitness. However, there are only few studies that have examined the relationship between obesity and other components of physical fitness (i.e. flexibility, muscular strength and endurance, speed/agility), particularly at the age of childhood. Thus, the aim of this study was to determine the possible influence of obesity on fitness parameters in primary school children.

149 primary school children (age:  $9.6 \pm 1.2$  years) underwent several physical fitness tests, which included sit-and-reach, standing long jump, 30 seconds sit-ups, 10x5 meters shuttle run, and 20 meters shuttle run test. Obesity was estimated by the Body Mass Index (BMI), computed as the ratio of body mass to squared height. The 85th and 95th BMI age- and sex-related percentile values were used as cut-off points for overweight and obesity, respectively. MANOVA was used to verify the statistical significance of the observed differences. 67.8% of the participants had a normal BMI, 16.1% were overweight and 16.1 were obese, with statistical differences between sexes ( $p=.001$ ). Normal boys obtained better performance than obese boys for standing long jump ( $p=.01$ ), 10x5m shuttle run ( $p=.001$ ) and 20 meters shuttle run test ( $p=.001$ ). Although normal weighted girls had generally better fitness levels than obese girls, no significant differences were found. In the comparison of physical fitness tests between sexes, normal weighted boys obtained better results than normal weighted girls for all tests ( $p<.05$ ), except flexibility. In overweight children, sex differences were exhibited in muscle strength ( $p=.004$ ), muscle endurance ( $p=.03$ ), agility ( $p=.01$ ) and predicted aerobic endurance ( $p=.006$ ).

This study demonstrated that obesity is a limiting factor for fitness performance in primary school boys, especially as measured by standing long jump test, 10x5 meters shuttle run, sit-up and 20 meters shuttle run tests. However, the absence of significant differences among girls is not in line with previous reports and should be further investigated. Although significant gender differences were found within the normal and overweight groups, there is no definite explanation as to why increase in BMI results in no difference of physical fitness between sexes.

Council of Europe (1983). *Testing Physical Fitness: EUROFIT*

Leger A, Lambert J (1982). *Eur J Appl Physiol* 49: 1-12

Kikuchi S et al (1995). *J Epidemiol Community Health* 83: 1625-27

## P12U-02

**"Ripe Apples" - a health promoting project for older women in rural regions****Dikettmüller Rosa, Kolb Michael**

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*Keywords: elderly, health promotion, community*

The development of measures for increasing the health awareness of older women is an issue that not oft been focussed upon, yet. As they grow older however, women are confronted with changes in their developmental tasks, through critical experiences and in their available social and personal physical resources. In order to overcome health problems that occur with age related changes in their way of life, solutions have to be based on the available resources, and adapted according to each situation. In the view of the various social situations, health awareness interventions must orient themselves closely within the context of real life situations of this clearly defined target group, and with active educational efforts, find a common ground for the development of adequate solutions, as well as initiate an enduring implementation.

As an example of the "ripe apples" project, an endeavour by the state of Styria will be presented. In this project, regular encounter groups have been established for older women in small communities and intend to strengthen the personnel resources and structural development in rural regions in the long term, as well as facilitate the understanding of the specific needs of older women. In the evaluation, an initiating structural analysis, accompanying documents of the process (project maps, diaries of the meetings etc.) and qualitative interviews with the group leaders, participants and officers of the communities are utilised. The results identify the criteria, which are responsible for failure or success.

The project is still in progress within ten communities, yet there is a great demand for more groups. The main aim – the establishment of sustainable structures – seems to be realistic. Additionally, what is meaningful is the level of engagement of the officials of a community. Supplemental physical activities and sports – although if they are not obligatory – are important aspects within the regular meetings.

One of the main problems is the absence of group leaders, which should be members of the communities. Another point of discussion is the age of the participating women, which has a range in average of between 50 and 65. In this project the agenda, or the leaders themselves seem to appeal especially to "younger" older women and not to the women aged 70 or older. For motivating this specific age group to engage in health promoting activities it seems to be necessary to differentiate in more clearly defined target groups with specific interests and needs.

## P12U-03

**Effects of a weight maintenance program with or without exercise training on serum leptin in obese men**

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*Keywords: leptin, resistance strength training, weight maintenance*

Serum leptin is often increased in obesity and decreases after successful weight reduction (WR). WR achieved through exercise training or dietary energy restriction may affect leptin differently. We studied whether adding exercise training to diet counselling after WR improves WM and how this affects serum leptin concentrations in obese men.

Ninety men with a BMI range 30-40 and a waist girth > 100 cm were accepted. After a very-low-energy diet for 2 months (mo.) (WR) they were randomized into walking (W), resistance training (R) or control (C), groups for 6 mo. (WM). Exercise groups trained 3 x 45 min/wk (W 60-70 % of VO<sub>2</sub>max, R 60-80 % of 1 RM). All groups received similar dietary advice.

After WM there was a 23-mo. follow-up. Body composition was assessed using underwater weighing. Serum leptin determinations were done by radioimmunoassay. After WR the mean weight loss was 14.2 (SD 4.0) kg. Weight remained almost unchanged during WM (n=82). At the end of the study (n=68) the mean weight decrease from the baseline was 4.8 (SD 0.8) kg with no statistically significant differences between the groups. Fat mass behaved similarly than body weight. VO<sub>2</sub>max increased after WM and more after follow-up with no differences between the groups. At the end of the study the increase in the whole group was 0.28 l/min (CI 0.20; 0.35) (vs. baseline 3.33 l/min). The mean serum leptin concentration was 11.7 (SD 5.1) µg/l at start, 5.1 (3.0) after WR, 6.9 (4.4) after WM and 10.0 (5.5) at the end, which was below the baseline level (difference -1.2, CI -2.1; -0.2). Changes in leptin at 8 and 31 mo. vs. baseline did not differ between the 3 groups (ANCOVA; measurements before WR as covariates).

Structured physical exercise, either walking or resistance training of moderate energy expenditure and intensity for 6 months, when added to diet counseling could not improve weight maintenance in weight reduced men in a longterm follow-up, when compared to diet only. The most likely explanations for the lack of between-group differences in serum leptin are too small a prescribed exercise volume and moderate adherence to exercise prescription. The effect of dietary changes (decreased energy intake) on energy balance may be larger and easier to achieve than to increase physical activity when aiming at longterm weight maintenance in middle-aged obese men. However, at the end of our study body weight, fat mass and serum leptin concentrations were reduced compared to the baseline.

*Borg et al (2002). Int J Obes 26: 676-83*

*Fogelholm M, Kukkonen-Harjula K (2000). Obes Rev 1: 95-111*

*Fogelholm M et al (2000). Arch Intern Med 160: 2177-84*

## P12U-04

**Physical activity as treatment for psychiatric patients**

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Sogn and Fjordane University College, Norway

*Keywords: health, Asberger's syndrome, shizophrenia*

This study focuses on physical, psychological and social experiences during and after 8 months aerobic training for a person with Asberger's syndrome (Rune), and one with shizophrenia (John). There are both qualitative and quantitative methods used in the approach.

Methods included questionnaire about social climate and cohesion, observation, interview and self-reporting immediately experience of the training. Bruce treadmill test was used to assess VO<sub>2</sub> max, VO<sub>2</sub> in l/min, heart rate (HR) and the performance time. Astrand/Ryhming test was used to estimate max VO<sub>2</sub> and to measure the lactat level on 100W strain when the HR was stable.

The result showed that the VO<sub>2</sub> max had increased, the lactate level had become lower, the performance time improved. The VO<sub>2</sub> measured in l/min became larger and they could do the same amount of work at a lower HR. Rune self-reported that all training sessions were good and "its fun playing ballgames, but its tiring beeing active". His puls are on the highest close to 100% of max. John says "the training is very hard and gives me more energy and a better well-beeing and mood". His pulse is on the highest 80 - 90% of max. They both says the groupmembers support each other, have fun, no arguing, often laughing, are focused on positive aspects and they are getting better in listening to the coach. The employees report that "Rune participates more and more, he is sweating, from not catching the ball at all, to now reaching out his arms to catch it, and he does it better and better. He concentrates and gives purposeful passes, and shows a growing participation. His physical fitness is getting much better. His mood has improved, he shows happiness and he takes initiative. About John they say "the most important development is that he is improving in getting to daily appointments on time. He has improved in his self-confidence, and is taking initiative like going to bars for watching footballgames on TV etc. He is training a lot more than he used to and he wants to go on improving and is using literature to find out how he can do it. These two persons have lived a steady life for many years. There were no other changes in these subjects' lives this year which would have caused the physical and psychological changes they experienced. I see it as important that the training lessons were at the same day and time every week, and the coaches were the same persons all year.

## P12U-05

**Predicting physical activity, using components of the transtheoretical model of behavior change: A longitudinal study**

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*Keywords: behavioral pattern*

The Transtheoretical or "Stages of Change" Model (TTM) is a theory studying behavioural changes, including exercise behaviour (Prochaska & DiClemente, 1983). Most of the published literature examining TTM and physical activity to date has been limited to cross-sectional designs. In the present study components of TTM were examined

longitudinally, with the purpose to test the ability of the TTM to predict physical activity in adults.

Participants surveyed at baseline (Time 1) and eight months later (Time 2). Attrition resulted in complete data available on 73.8% of the original sample (N=191). The final sample of the study consisted of 141 adults (M= 26 years) who completed a questionnaire assessing their weekly physical activity and components of TTM (stage of exercise behaviour, exercise self-efficacy, and exercise pros and cons) at both times of assessment.

At Time 2, 41.8% of the sample maintained the same stage of change as baseline, while 34.8% regressed to a former stage and 22.7% progressed to an advanced one. In a multiple stepwise regression, were the components of TTM of baseline were entered, self efficacy was able to explain 26.9% of variance in physical activity at Time 2 ( $F=49.2$ ,  $p<0.01$ ). Results also indicated that stage of change at Time 1 explained 19% of variance in physical activity at Time 2 ( $F=10.9$ ,  $p<0.01$ ) of the individuals who relapsed or progressed to another stage. A MANOVA on the TTM components of Time 1 indicated that there was a significant difference in stage of change, self-efficacy, and cons of exercise at Time 1 ( $p<0.001$ ), between people who exercised adequately (more than 840 METS per week) and those who did not at Time 2. Furthermore, a MANOVA on the TTM components of Time 1, showed that only stage of change differed significantly between relapsers and progressers at Time 2 ( $p<0.001$ ).

The use of the Transtheoretical Model for the prediction of physical activity of an adult population over an eight month period was only partially supported. More studies examining the applicability of the model to the study of physical activity over various periods of times of various samples are suggested.

Prochaska JO, DiClemente CC (1983). *Journal of Consulting and Clinical Psychology*, 51, 390-395.

## P12U-06

### Chronological analysis of physical fitness results of Lithuanian girls of 5th - 12th forms

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Lithuanian Academy of Physical Education, Lithuania

**Keywords:** *physical education, fitness, Eurofit Tests*

The study is focused on the changes in physical fitness results of girls (11 to 18 years, 5th-12th forms) in respect to age, chronologically (1992-2002).

Physical fitness was established by Eurofit tests. The number of the subjects in each age group was 200-400 girls. Statistical significance was set at  $p<0.05$  (Students' t-test). The health related physical fitness (HRF) data concerning results of height and weight increased from 11 to 16 years of age ( $p<0.05$ ) while from 16 to 18 years of age no essential difference in the data has been registered. In most cases there was though inconsiderable but statistically significance ( $p<0.05$ ) increase in cardio respiratory endurance, muscular endurance and flexibility results up to 15 years of age. There was no significant increase ( $p>0.05$ ) in these results over 15 years of age. According to the results of each test conducted dynamics of skill related physical fitness (SRF) results has been registered up to 13 years ( $p<0.05$ ) and, frequently, up to 16 years of age. The early stabilisation of SRF results has been established in balance - from 16 years of age, strength - from 15 years, speed (in both 10x5 shuttle run and plate tapping test results) - from 13-14 years of age. There was no significantly relevant ( $p>0.05$ ) change in these results.

A comparative analysis of the results in the years 1992 and 2002 has revealed no essential differences ( $p>0.05$ ) in height, weight and bend arm hang test. There have been negative changes in the results of 20 m shuttle run and sit and reach tests. In all age groups, registered in the year 2002, these results were significantly worse ( $p<0.05$ ). The research done in the year 2002 revealed better results but in the dynamics of sit-up tests when compared with the respective results registered in 1992. Dynamics of SRF results (10x5 shuttle run, plate tapping, standing broad jump tests) during the last decade was also negative ( $p<0.05$ ) in all age groups analysed. These results in all age groups registered in 2002 were most frequently worse than those demonstrated in 1992.

In conclusion it could be asserted that tendencies in the changes of physical fitness results in respect to age and chronologically are negative.

## P12U-07

### Impact of a three-year multi-level intervention physical activity program on PA (physical activity) level

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**Keywords:** *health, physical activity levels, promotion*

The focus of this paper was to verify the program impact on population knowledge of the: a- program brand; b- purpose; and c- Physical activity levels, after three-year intervention in the Metropolitan area (comprising 16 million inhabitants).

Level of PA activity (active, irregularly active, sedentary) was determined using the International Physical Activity Questionnaire (IPAQ), version 8, short, last week form, obtained by means of a home-based interview (n: 645 - 1999; and n: 629 - 2002 men and women, over 18 yrs-old). It was carried out in three cities of São Paulo Metropolitan area. Sample was randomized according to sex, age, socio-economic, and educational status.

Positive recall for the program brand remained constant (53.0% x 52.8%, for 1999, 2002, respectively). However, a 60.6% increase ( $*p<0.01$ ) in program purpose knowledge was observed (19.5 x 31.3%). Data showed a slight increase in active people (54.8 x 56.8%), as light decline in irregularly active (30.3 x 28.1%); and a steady sedenteriness level (14.9 x 15.1%). A significant relative increase (23%) in walking was observed among those who have reached the CDC/ACSM recommendation (22.9 x 28.1%). When walking was not included, a 19.6% drop was observed in active group, and a 12.3% increase of insufficient active groups (60.3 x 67.7%). Among women regular activity decreased by 7.7% (61.0 to 56.3%) while the proportion of active men increased by 17.9% (48.7 to 57.4%). Knowledge of the program purpose seemed to not affect the level of active people (56 x 54%), but it did influence sedentarism, since it was higher (19.3 %) among those who did not know the Agita message than among who knew the program message (10-11%).

Positive program impact included: a- an increase (60.2%) in program purpose knowledge; b- a permanent high index (53%) of brand knowledge; c- an increase of 23% in walking, d- a lower risk for sedentariness among who knew the program purpose. three year multi-level intervention.

## P12U-08

**Influence of bisoprolol on exercise prescription of training heart rates**

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*Keywords: anaerobic threshold, beta blocker, aerobic training*

Exercise is recommended for cardiac patients irrespective of beta-blockers. The percent of maximal heart rate (%HRmax) and percent of heart rate reserve (%HRR) models are widely used to determine training intensities. The purpose of this study was to investigate the influence of chronic cardioselective beta blockade on the %HRmax and %HRR model. Ten healthy male subjects (mean±SD for age: 23±2.8yrs; height: 181±6.2cm; weight: 76±5.6kg) randomly received oral placebo or beta-blocker bisoprolol (5mg/day) for two weeks using a double-blind crossover design. In the second week, the subjects performed a cardiopulmonary exercise test until exhaustion to determine the aerobic (AeT) and anaerobic (AnT) thresholds.

No significant differences were found for absolute and relative values of oxygen consumption, power output and ratings of perceived exertion at AeT, AnT and maximum workload. Mean HR was significantly ( $P<0.05$ ) lower at rest ( $-15\pm 5$ bpm), AeT ( $-19\pm 8$ bpm), at AnT ( $-22\pm 10$ bpm) and maximal workload ( $-19\pm 11$ bpm) with bisoprolol compared to placebo. %HRmax was significantly ( $P<0.05$ ) reduced at rest (43 vs 39 %), and at AeT (64 vs 60%) and AnT (86 vs. 82%), a trend for a reduction was found for %HRR at AnT (75 vs 71%,  $P=0.07$ ).

We conclude that an exercise prescription using the %HRmax or %HRR method is of limited accuracy for patients taking beta-blockers. Although %HR and %HRR are easy to determine and therefore attractive, we suggest that the most precise exercise prescription would depend on AeT and AnT. The percentage of maximal oxygen consumption or maximal workload or ratings of perceived exertion may be suggested as a substitute. Alternatively, the upper limits for %HRmax and %HRR should be lower for patients taking beta-blockers.

## P12U-09

**Somatic, fitness and physical activity variation associated to maturational stage of female students**

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*Keywords: physical activity, girls, maturational stages*

The aim of this study is to understand the differences between different maturational stages, concerning their habits and behaviours, towards physical activity. In several studies, female gender report less daily physical activity (Greendorfer et al., 1996). We decided to focus on this group.

We observed 153 student girls, with ages between 12 and 16 years, from the 7th grade of several schools located on centre of Portugal. The sample was divided in 3 groups according to their maturational stage (Pre-pubescent, n=46; Middle-pubescent, n=42; Post-pubescent, n=65). Variables that were observed: somatic variables (weight, height, BMI), fitness variables (Cooper test; 20x5m run; manual dynamometer; modified sit and reach). We also applied questionnaires about physical activity and made individual interviews to know about the maturational stage.

We could find statistically significant differences between clusters (defined by the maturational stage) on their height, weight and, accordingly, on BMI. These results are in agreement with the literature. There were no differences found in fitness variables between groups, exception made for the manual dynamometer. The results for the manual dynamometer are also in agreement with the literature, as being positively associated to the dimension of subjects. In our sample pre-pubescent girls (who never had menarche) are more active than post-pubescent, even though post-pubescent girls (whose menarche has occurred more than one year ago) are more involved in organized sports. These results are independent of the girl's parent's physical activity. These findings suggest that the opportunities to engage in organized sports are more available to the elder girls. Football, next to bicycle and swimming, is one of the most enjoyed sports among all groups. This gives us two important informations: (1) not only boys enjoy Football; (2) the amount of activities most enjoyed is very limited, and are very traditional activities.

These conclusions may support some strategies to promote physical activity: (a) Change the age of recruiting girls, making it earlier, for formal sports, (b) Increase the number and diversity of activities accessible to all girls.

## P12U-10

**Greek adolescents, fitness, fatness, fat intake, activity and CHD risk**

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*Keywords: exercise, blood lipids, blood pressure*

Paediatric studies have indicated that unfavourable blood lipid and blood pressure profiles may be associated with an array of different lifestyle parameters including poor aerobic fitness, obesity, increased dietary fat intake and inadequate levels of physical activity. Recent studies in children have further suggested that lipid and blood pressure profiles are mediated mainly by body fatness, rather than fitness and other confounding variables. However, there is controversy about the independent effects of certain lifestyle parameters on primary coronary heart disease (CHD) risk factors.

In Greece, a dramatic increase in adult morbidity and mortality rates from CHD, accompanied by increased prevalence of CHD risk factors in children, has been documented. Given the dearth of relevant information in Greece, we examined the independence and relative strengths of association between fitness, fatness, fat intake and/or physical activity, and six CHD risk factors (HDL-C, HDL-C/TC, LDL-C, TG, SBP, DBP) in 210 12-year old Greek pupils, in order to further explore this issue. Subjects underwent anthropometric, maturity, aerobic fitness, fat intake, physical activity, blood lipid and blood pressure assessments. Correcting for gender and maturation, standardised regression coefficients revealed three significant associations between the six CHD risk factors and activity levels, compared to one of six for fatness and none of six for fitness and fat intake. These results indicate that, in Greek schoolchildren, primary CHD risk factors are mainly affected by physical activity levels, independently of fitness, fatness and/or fat intake. Prevention strategies should concentrate on enhancing physical activity early in life, if the increased prevalence of Greek adult CHD morbidity and mortality is to be diminished.

## P12U-11

**The role of recreational sport as the factor of the quality of tourism supply****Andrijasevic Mirna**

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*Keywords: tourism, recreational sport*

Recreational sport is regarded as an essential component of modern tourism-related supply which aims at meeting the requirements of tourists today as regards the possibility to spend an active, sport-oriented vacation. Modern man is highly health-conscious and knows that, among many other ways, health can be protected and promoted through sport activity participation. Therefore, physical exercising represents the foundation for planning and programming the contents of supply that regards recreational sport in tourism. The contents of contemporary tourism-related supply are, therefore, directed towards creating such programs that would both meet the demands of tourists, as regards sport activity participation, and increase the degree of quality of tourist centres. The recreational sport programs in tourism may be a generator of numerous positive effects. The structure of recreational-sport supply in tourism may be regarded as complex; however, an attempt was made here to present a scheme of basic, supplementary and additional recreational sport programs, together with the role of personal participating in the realization of these programs. Due to the abundance and diversity of contents, related herewith, contemporary tourism differentiates between various degrees of quality, where recreational sport may have an important role. In order to reach a satisfactory quality of recreational sport supply in tourism, it is essential that the existing tourist resources are re-evaluated taking into account the objective and subjective needs of the market. The review and the evaluation of recreational sport programs in tourism may significantly influence the creation of the total tourism-related supply.

## P12U-12

**The test-retest reliability and method comparison validity of the 20m multi-stage shuttle run and the 12-minute Cooper run/walk estimates of maximal aerobic capacity****Lamb Kevin, Humphreys Laura**

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*Keywords: field testing*

The purpose of this study was to examine the test-retest reliability and method comparison validity of two popular predictive 'field' tests of maximal aerobic capacity using traditional and contemporary statistical analysis techniques. Forty-one recreational sportsmen (mean age: 20.0 ± 1.8 years; height: 1.82 ± 6.9 m; mass: 83.3 ± 11.2 kg) volunteered to take part in two repeated trials of the 20m Multi-Stage Shuttle Test (MST) and the 12-minute Cooper Run/Walk (CR). The maximal aerobic capacity values were derived for each test from published regression equations (based upon the stage reached for the MST and the distance covered for the CR) and were compared (intra- and inter-method) via correlation, paired t-test and the 95% Limits of Agreement (LoA) techniques.

Mean predicted values for trial 1 and trial 2 were 45.0 (± 5.5) and 46.7 (± 5.7) ml/kg/min for the CR and 56.0 (± 4.6) and 56.7 (± 5.1) ml/kg/min for the MST, respectively. In terms of

reliability, both methods yielded high Pearson ( $r > 0.90$ ) and intraclass ( $R > 0.92$ ) correlations and low mean test-retest differences ( $< -1.70$  ml/kg/min), suggesting acceptable test-retest consistency. Additionally, the random (within-subjects) error component of the LoA was ± 4.6 ml/kg/min (CR) and ± 3.1 ml/kg/min (MST). Expressed relative to the overall ('grand') mean of the two trials, this variability equated to ± 10.1% and ± 5.5% for CR and MST, respectively.

In terms of method comparison validity, the Pearson correlations between the MST and CR estimates were also favourable (0.85 in trial 1 and 0.86 in trial 2), but mean values differed considerably (by 11.1 and 10.0 ml/kg/min, respectively).

Moreover, random variations of ± 5.5 ml/kg/min (± 10.8%) in trial 1 and ± 6.0 ml/kg/min (± 11.6%) in trial 2 on top of these biases highlight that for most of our participants the two field measures gave estimations that were quite different. It was concluded that whilst both methods were shown to demonstrate adequate reliability, the CR test produced predictions that were systematically lower than the MST test, suggesting that, in the absence of knowledge of their criterion validity, the two field tests ought not to be used interchangeably.

## P12U-13

**Occupational fitness screening of fire fighters****Claessens Albrecht, Van Langendonck Leen, Moons Dries, Vandewiele Filip**

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*Keywords: firefighters, body composition, motor performance*

Literature shows that fire fighting is one of the most physical demanding jobs. It is obvious, regarding the safety of the firemen and the population that fire fighters need to be in an excellent physical condition to be able to do this demanding job. It has been shown that fire fighting tasks as climbing fire-escapes, hoisting jobs, forcing an entry, saving victims are significantly related to factors as stature, body mass, body composition estimates, strength and endurance capacity. The purpose of this study is twofold: (1) screening the physical fitness of a professional fire brigade of a medium-sized town in Flanders, Belgium and (2) testing the influence of a training program on the physical fitness of this group.

The sample consisted of 95 professional firemen (42.0 ± 9.1 years). Stature and body mass were measured. Body composition was estimated by BIA. Physical condition was determined using the EUROFIT test battery. During 4 months the subjects performed twice a week an exercise program. Of 81 subjects complete data of test session 1 and test session 2 were available.

High values for BMI (27.0 ± 3.1 kg/m<sup>2</sup>) and percent body fat (25.5 ± 4.4%) and a low score for endurance capacity were observed. Correlation analyses demonstrate that motor capacity decreases with ageing. Analysing the differences (Test session 2 - Test session 1) indicate that there were no significant changes in physical fitness over the 4 months training period. Comparing two groups with different number of attended training sessions did not reveal any significant differences between the two groups.

It can be concluded that (1) the fire fighters of the fire brigade under study were rather old; (2) the high BMI and high percent body fat had a negative influence on the motor performances and on health in general; (3) the performance on the endurance shuttle run was, on average, weak with the result that the suggested norm in the literature was not reached; (4) the training program did not gain the desired results.

## P12U-14

**A comparison of predictive tests of aerobic fitness****Rahimi Moghaddam Seyed Reza, Sharei Halimberdi**

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*Keywords: VO2max, CAFT, Astrand Step Test*

Aerobic fitness is one of the most important factors in physical fitness. Measuring of aerobic fitness needs a confident and acceptable index. Due to lack of expensive laboratory equipment for many trainers or P.E instructors, using of field and step tests is the best way to predict of aerobic fitness. The purpose of this study was to compare the results from Astrand Step Test (ST), Canadian Aerobic Fitness Test (CAFT) and 1.5 Mile Run Test (DR).

Thirty-three male students of Rasht physical education high school aged 15-18 years (Mean  $\pm$  S.D 16.56  $\pm$  0.85) participated in the study. All subjects performed three predictive tests. Predicted VO2max scores were obtained for each subject.

The mean $\pm$ S.D from the various tests in ml.kg<sup>-1</sup>.min<sup>-1</sup> were as follows: ST 57.18  $\pm$  6.88; CAFT 58.10  $\pm$  5.08 and DR 52.40  $\pm$  5.09. Significant correlations were found among the VO2max results on all possible pairing of tests ( $p < 0.05$ ). Correlation coefficients between ST/DR and ST/CAFT were 0.92 and 0.84 respectively. While the correlation coefficient between CAFT and DR was 0.88.

The results are in line with similar studies, which have been done before (Anderson, G.S.1992; Jette, M. 1979). The findings indicate that each of the three tests can be used as a predictor of aerobic fitness.

preparedness of military personnel. Young man – recruit has specific load (physical, psychological) that can aggravate health problems and cause pathological changes in bony structure (osteoporosis, stress fracture). The aim of our investigation was select risk group of recruits and by using different methods of investigation and supposes main direction of prophylactic measures.

Our investigation embraced about 75 recruits. We conduct questionnaires about presence stress fracture factors influence, psychological examination, and physical development analysis. We selected risk group and control group (total number of examined person were 20) and made laboratory test and instrumental diagnostics.

Recruits aged from 18 to 23 years undergone basic military training program (10 weeks). The risk group and control groups were selected after questionnaire data analysis. The main risk factors were smoking, alcohol toxic effect, low physical activity, non-regular nutrition, medical remedies, and psychological factor. Questionnaire about civil life period is important step for revealing person with damaging bone structures and selecting risk group. Osteodensitometry revealed pathological changes in bone constitution in 50 % in examined group. Prophylactic measurements after diagnostic of pathologic changes in bone constitution included rational nourishment; inadequate physical load, assimilation calcium and D vitamin, solving psychology problem sand decreased harmful risk factors impact concerning stress fracture

The anamnesis, laboratory test and instrumental diagnostic methods are important and objective data about statement of recruits' bone and its structure. Osteodensitometry should be used as selecting investigation method. Prophylactic measures diminish rate of pathological changes (fracture, osteoporosis and osteopenia) of recruits during military service.

## P12U-15

**Pathological effect of physical load in recruits****Plavina Liana, Sneiders Edgars, Umbrasko Arkadijs**

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*Keywords: physical load, pathological effect, recruits*

Defense possibilities of Armed forces depend on professional, physical endurance and psychological

**Poster Session****Nutrition 1 – Biochemistry 1 - Molecular Biology 1****P12V**

## P12V-01

**Eurycoma longifolia jack as ergogenic aid - a pilot study****Hamzah Sareena Hanim, Yusoff Ashril**

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*Keywords: muscle strength, ergogenics*

It has been reported that a traditional medicine, Eurycoma longifolia Jack, has aphrodisiac properties where it enhanced sexual activities and increased testosterone level in man. Previous studies have now established that the testosterone supplementation does increase fat free mass, muscle strength and muscle mass, which are important for physical function and athletic performance. Thus, the objective of this study is to investigate the increase of testosterone level via administration of this herb on body composition and muscle strength and size in man.

14 healthy men performed an intense strength training programme with initial load of 60% RM (2 sets of 10 repetitions with 1 minute rest in between, for 10 stations) on alternate days for 5 weeks. Simultaneously, 7 men were randomly selected to consume 100 mg/d Eurycoma water soluble extract and 7 men received placebo. The intensity of the exercise was increased 10% RM / wk. Body composition, arm circumference, one repetition maximum (1 RM) and surface electromyographic (sEMG) activity were measured and recorded 1 day prior and after the 5 weeks period of the experiment.

Fat free mass of the treatment group showed a significant increment i.e. from 52.26  $\pm$  7.18 kg to 54.39  $\pm$  7.43 kg ( $p = 0.012$ ) but no significant changes in fat free mass in placebo. Body fat % were significantly decreased in treatment and placebo, i.e. from 31.30  $\pm$  5.48 % to 28.44  $\pm$  6.43 % ( $p = 0.01$ ), and from 22.83  $\pm$  2.43 % to 21.33  $\pm$  2.35 % ( $p = 0.001$ ), respectively. The 1 RM test showed a significant

increased from  $73.71 \pm 16.63$  kg to  $78.71 \pm 17.0$  kg ( $p=0.006$ ) in treatment and from  $77.29 \pm 8.9$  kg to  $79.43 \pm 8.83$  kg ( $p=0.011$ ) in placebo. Greater increment in strength was shown in treatment compared to placebo (6.78% and 2.77%, respectively). The mean frequency of sEMG on bicep in treatment and placebo showed significant decrement in values i.e. from  $121.77 \pm 40.0$  mV to  $90.47 \pm 64.6$  mV ( $p=0.012$ ) and, from  $127.95 \pm 30.9$  mV to  $98.8 \pm 50.1$  mV ( $p=0.036$ ), respectively. The treatment showed 2.92% higher reduction in electrical activity of the muscle measured at the end of the experiment compared to placebo. The mean arm circumference of treatment group increased significantly by 1.8 cm following the supplementation i.e. from  $30.87 \pm 1.88$  cm to  $32.67 \pm 1.96$  cm ( $p=0.011$ ) but not significant in placebo.

The results obtained suggest that water soluble extract of *Eurycoma longifolia* Jack increased fat free mass, reduced body fat, increased muscle strength and size, thus could have ergogenic effect. Further investigations are warranted.

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Brodsky IG et al (1996). *Journal of Clinical Endocrinology and Metabolism*, 81: 3469-3475

Ismail MTM (2002). *Proceeding Paper – Asian Congress of Sexology*

## P12V-02

### The influence of a carbohydrate/protein sports drink on soccer sprint performance

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**Keywords:** soccer, performance, carbohydrate ingestion

Athletes require a constant supply of fuel and fluids in order to maintain performance during a given race, game, or training. The average energy expenditure pattern for competitive soccer players is about 75% of maximal aerobic power (Reilly, 1997). At such outputs, the demands on endogenous carbohydrate are high. If premature glycogen depletion or decreased carbohydrate oxidation occurs, performance will suffer. Thus, substrate availability is crucial in maintaining, or even increasing intensity and performance. The purpose of this study was to observe the effects of sports drink ingestion on sprint performance in collegiate soccer players during on field testing.

15 female soccer players, NCAA Division II level, participated in this blinded study using a placebo treatment in a crossover design. All players either received the sports drink (Accelerade, PacificHealth Laboratories, Woodbridge, NJ) that contained 26 g of carbohydrates, 6.5 g of protein, 190 mg sodium, and 64 mg potassium in 360 mL or a placebo. The placebo was similar to the sports drink in taste, texture, and electrolytes, but lacked the carbohydrate and protein. Practices consisted of 75 minutes of a brief warm-up, skill development, and 40 minutes of high intensity scrimmage. Six-150 mL drinks were ingested over the 75 minute practice. Immediately following practice, players completed 4 sprints through a 280 m course. Each sprint was separated by a 5 minute recovery period. The course was made of 143 m of a zigzag sprinting followed immediately by 137 m of straight sprinting.

Average sprint times (mean  $\pm$  std dev) for the Accelerade trial were 92.6 (5), 94.4 (4), 95.0 (5), and 91.5 (5) seconds. Average times for the placebo trial were 92.7 (4), 94.5 (4), 96.1 (5), and 95.5 (4) seconds. Statistical analysis revealed that times for the last sprint were significantly different ( $p<0.05$ ) between treatments. This difference amounted to

4.2% between treatments. Players also demonstrated more touches of the ball during the scrimmage when they ingested the carbohydrate/protein beverage. No adverse effects of drinking either beverage were reported.

Results of this study demonstrate that when trained soccer players ingested a carbohydrate/protein beverage during high intensity practice, fatigue was minimized and sprint performance enhanced.

Reilly T (1997). *J Sports Sci*, 15:257-263

## P12V-03

### Creatine pyruvate increases performance during cycling of high intensity

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**Keywords:** endurance performance, ammonia, creatine supplementation

It was hypothesized that Creatine-Pyruvate and Creatine-Citrate might have a beneficial effect on fatigue resistance during exercise of high intensity maybe due to a stimulation of the aerobic metabolism. In a placebo controlled double blind study the effects of Creatine-Pyruvate and Creatine-Citrate (Degussa) were tested during cycle ergometry at 95 % of VO<sub>2</sub>max 45 subjects took part in the study. They were assigned to 3 supplementation groups. The groups were matched for VO<sub>2</sub>max. The cycle test (excalibur sport) consisted of 3 parts: warming up at 10 % of maximum workload (WLmax,) pre-period with 65 % of WLmax and the test-period with 80 % of WLmax corresponding to 95 % of VO<sub>2</sub>max. The subjects had to perform until subjective exhaustion. VO<sub>2</sub>, VCO<sub>2</sub> and Ventilation were measured breath by breath (oxycon sigma). Blood was taken from a hyperaemized earlobe to determine lactate in arterialized blood. In plasma of cubital venous blood NH<sub>3</sub> was measured. Blood was sampled after each exercise period and after 5 min and at the end of the test-period. Heart rate was monitored by a pulstester (Polar Electro). Supplementation lasted for 28 days. The subjects had to take 5 g Creatine-Pyruvate or Creatine-Citrate in an effervescent formulation corresponding to 3 g and 3.4 g Creatine per day, respectively, or a placebo.

[Lac] in arterialized blood at the end of the different periods were similar under all conditions. Even at exhaustion there was no difference due to the application of different preparations. The same holds true for heart rate, VO<sub>2</sub>, VCO<sub>2</sub> and RQ. Additionally there was no influence of either substance on mean performance times of the whole groups. If the groups are divided into subgroups the picture is different. Subjects exercising less than ten minutes in the pre-test ( $n = 9$ ) increased mean performance time by about 15 % after Cr-Pyr ( $p<0.05$ ). After Cr-Cit and placebo there was no significant difference. In those subjects performing longer than 10 minutes there was no significant change in performance times in either group. After Cr-Pyr in the total group the increase in NH<sub>3</sub> was significantly smaller ( $p<0.01$ ) compared to the pre test. In other groups there was no significant difference

The results show that Cr-Pyr has a beneficial effect on endurance performance during exercise of high intensity. The benefit seems to be limited to intensities leading to exhaustion within 10 min. The increase in performance might be due to a reduced ADP-formation.



## P12V-04

**Study of the influence of Chinese Herbal Medicine on athletes' body function**

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*Keywords: athletes, medicine*

The research purpose is to observe the "Changbai Jingxianling" - a Chinese herbal medicine - function to sport athletes. There were twelve track and field athletes and twelve bicyclist athletes who took the "Changbai Jingxianling" liquid, and the physiology and biochemistry indexes were measured four times in the observing period. Then, the results and the function of the "Changbai Jingxianling" were statistically analysed.

The athletes took the "Changbai Jingxianling" liquid once in the morning and in the evening every day and 20 ml every time. During the time of taking the medicine, the athletes were trained normally and did not take any other nourishing medicine, the meals did not change either. The physiology and biochemistry indexes measured are: Hemoglobin (Hb), Testosterone (Te), Creatine Kinase (CK), Blood Urea (Bu), cardiac output (Co), and so on.

After taking the medicine for 15 days, 30 days and 45 days, the athletes' Hb has increased from  $13.5 \pm 1.4$  g/dl before to  $14.1 \pm 1.7$  g/dl,  $14.5 \pm 1.9$  and  $14.6 \pm 2.0$  g/dl. About 84.3% of all athletes' Hb increased. The Te has increased from  $4.5 \pm 1.7$  ng/dl before to  $5.0 \pm 1.9$  ng/dl,  $5.3 \pm 2.0$  and  $5.5 \pm 2.3$  g/dl. The Co has increased from  $98.5 \pm 21.3$  ml/beat before to  $110.5 \pm 25.3$  ml/beat,  $117.2 \pm 28.7$  ml/beat,  $121.8 \pm 29.3$  ml/beat. The CK has decreased from  $432 \pm 62$  U/L before to  $378 \pm 56$  U/L,  $356 \pm 52$  U/L,  $337 \pm 49$  U/L. The Bu has decreased from  $7.8 \pm 2.3$  mmol/L before to  $7.3 \pm 2.2$  mmol/L,  $6.8 \pm 1.8$  mmol/L,  $6.7 \pm 1.8$  mmol/L.

The results of this study show that: a) the "Changbai Jingxianling" can increase Hb, Te, Co of the athlete, it maybe one of sport nurture to increase Hb, Te and Co; b) the "Changbai Jingxianling" can decrease CK and Bu metabolism of the body, it prevents body from fatigue.

Chao xin et al (2000). *Control of Some Physiological and Biochemical Indexes Combined With subjective Sensitivity of Fatigue in Swimming Training*. J of Beijing University of Physical Education, Vol. 23, 189-190

## P12V-05

**Training monitoring through blood acid-base parameters in elite female rowers**

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*Keywords: rowing, acid-base equilibrium, training monitoring*

Our observations refer to girl-rowers who ranked up in the world elite. Their ABE values were determined with a blood pH analyzer type ABL2. The subjects ( $n=17$ ) are about 24.6 ys, with a lean muscle weight of 65.4 kg, a  $VO_2$  max of 66.6 ml/min/kg and a Hb of 13.8 g%. All the athletes trained for 6 months in similar conditions. The investigation focuses on four different 2400 m ergometer trials (I-IV) performed at a maximal intensity, average power of 279 W and a HR of 183 bpm. Taking into consideration the fact that in different testing stages the ABE values are characterized by a high degree of variance which does not allow a proper statistical analysis and that we investigate the same effort sample, we chose to use in our statistics the method of concatenation of data; 3' after a maximal exercise, the main AB parameters (ABp) were as follows: pH decreases at 7.178 (I), 7.153 (II),

7.054 (III) and 7.039 units (IV),  $pCO_2$  lowers to 29.6 (I), 28.8 (II), 32.3 (III) and 31 mm Hg (IV), while  $HCO_3$  to 10.7 (I), 9.6 (II), 8.54 (III) and 7.9 mmol/l (IV) and the BE decrease to -16.6 (I), -18.1 (II), -21.5 (III) and to -22.6 mmol/l (IV). This ABE picture describes a strong metabolic acidosis. The variance of all values is huge and the distribution for any ABp is not a gaussian one. The level of the ABE alteration with maximal exercise seems to decrease to a certain extent along the total period of training. The Pearson correlation test reveals a strong relation between power and pH ( $r=0.5$ ) and power and  $HCO_3$  ( $r=0.5$ ). PH also presents a high correlation with  $HCO_3$  ( $r=0.8$ ), but not with  $pCO_2$  ( $r=0.06$ ). On the other hand, this last parameter is satisfying in relation with  $HCO_3$  ( $r=0.4$ ) and with lean muscle mass ( $r=0.45$ ). One should notice that postexercise metabolic acidosis in elite rowing is followed by an immediate weak response of the respiratory buffer, but of efficient one of the buffer chemical systems, especially of the  $HCO_3$ .

Like many biochemical parameters the AB response in elite athletes has an enormous variability. Because of these important characteristics and of ever small number of such individuals, training monitoring tends to individual longitudinal research. And in this case, the most usefully ABE are pH and  $HCO_3$ .

## P12V-06

**Endurance training modulates heat shock protein expression in streptozotocin-induced diabetic rats**

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*Keywords: exercise, oxidative stress, heat shock protein*

Acute exercise induces oxidative stress and modification of intracellular proteins. Regular exercise upregulates the endogenous antioxidant protection potentially via induction of heat shock proteins (HSPs). HSPs maintains and re-establishes protein structure and function after damaging insults. It is suggested that in diabetes, tissues are more vulnerable to increased oxidative stress and modification of intracellular proteins due to a failure of the endogenous defence systems.

We examined the effects of acute exercise and endurance training on heat shock proteins and the potential mediators of this response, protein carbonyls and 4-hydroxynonenal in Streptozotocin-induced diabetes model. The rats were divided into untrained and endurance trained groups. Half of each group was further exposed to one acute bout of exercise. Tissues were collected before and after acute exercise in each group. Protein carbonyls and expression of heat shock proteins were analysed using Western blot.

Induction of diabetes decreased Hsp72 and increased Hsp90 in the heart; increased HO-1 and Grp75 in the liver; and increased protein carbonyls in vastus lateralis. Acute exercise increased Hsp90 in the heart. This effect was not observed in endurance-trained rats. Endurance training alone had no effect on HSP levels. Acute exercise increased 4-HNE in heart and liver. Acute exercise also increased protein carbonyl levels in the gastrocnemius and vastus lateralis muscles. Such oxidative damage was not observed in endurance trained rats. Endurance training increased HO-1 and Grp75 in gastrocnemius and Hsp72 in vastus lateralis muscles.

Our results suggest that endurance training may protect tissues to exercise-associated oxidant insults by up-regulating HSP expression in diabetic animals.

#### P12V-07

### Cellular and biochemical responses to exercise-induced oxidative stress: relationship with fitness level

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**Keywords:** oxidative stress, reactive oxygen species, cellular damage

Reactive oxygen species (ROS) production is stimulated by exercise, and ROS can activate different pathways leading either to cellular growth, apoptosis and adaptation, or to cellular damages and endogenous antioxidants consumption (Fehrenbach and Northoff 2001). There is also some evidence that vigorous exercise causes oxidative stress (Polidori et al. 2000). On the other hand, moderate and long-term training could lead to adaptive responses (Radak et al. 2002; Ji 2002).

In order to study the relationship between fitness level, indicated by VO<sub>2</sub>max, and the cellular and molecular responses to vigorous exercise, we compared the rate of micronuclei (MN) and apoptosis induction in lymphocytes, reflecting DNA damage, as well as some molecular and biochemical markers of oxidative stress, before and after an exhaustive physical test in 12 young males, 6 with VO<sub>2</sub>max 56.7±2.1 ml/min/kg and 6 with VO<sub>2</sub>max 47.1±3.6 ml/min/kg. Subjects with higher VO<sub>2</sub>max showed no variation between frequency of spontaneous MN at time 0', and at both 30' and 24hr after the exercise, whereas in the sample with lower VO<sub>2</sub>max a rise in MN frequency after 24h was observed, and all the values tended to be substantially higher than those of the other group. Exhaustive exercise did not determine specific induction of apoptosis, nor was there any significant difference between the two groups. TAS and ascorbic acid concentration did not appear to be affected by fitness differences. The oxidised (GSSG)/reduced (GSH) glutathione ratio was altered. Particularly, in subjects with lower VO<sub>2</sub>max the ratio increased from 0.044 (at 0') to 0.079 (30' after exercise) and 0.12 (24 hr after). On the contrary, subjects with higher VO<sub>2</sub>max showed more resistance to oxidative stress. Regarding the Hsp70 expression, after exercise the protein levels changed, but there was no correlation with fitness level.

Up to now, our results seem to indicate that the power of exhaustive physical activity in causing oxidative stress and cellular damage in healthy young men depends on the fitness level. Actually, in the subjects with higher VO<sub>2</sub>max this potentially harmful effect seems to be balanced by overcompensation against ROS production, as shown by the GSSG/GSH ratio values that are confirmed by the micronuclei findings.

Fehrenbach E, Northoff H (2001). *Exerc Immunol Rev* 7: 66-89

Polidori MC et al (2000). *Int J Sports Med* 21(3):154-7

Radak Z et al (2002)

Pfluger. *Arch.* 445(2): 273-8, Ji LL (2002). *Ann. NY Acad. Sci.* 959: 82-92

#### P12V-08

### Cross-influences between exercise biochemists of Ukraine, Russia and USA in the 20th century

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**Keywords:** history, exercise, biochemistry

Although Ukraine and Russia have a long history of studies in Exercise Biochemistry, much of the information is difficult to obtain in the West. The purpose of the study was to establish some scientific links involved in the evolution of sport research, in particular the influences shared by the scientists in Ukraine, USA and Russia.

Topics covered include research on the characterization of exercise cAMP metabolism and the developed controversy over the role of lactic acid in muscle function and fatigue. Pioneering studies of the effect of exercise and exercise training on cAMP-dependent protein phosphorylation were first performed in Ukraine. It was established that the activity of adenylate cyclase and cAMP-dependent protein kinase of cardiac and skeletal muscle were increased as a result of exercise training. These changes depended on the length of exercise training. Further, it was shown, that changes in protein phosphorylation may have adaptive significance leading to decreased cathepsin D release from lysosome of skeletal muscle and heart of rats during exercise and increased glycolysis as well as increases in Ca<sup>2+</sup> transport in the sarcoplasmic reticulum and sarcolemma, which in turn may enhance contractile and relaxation properties in cardiac and skeletal muscle. While Russian scientists emphasized lactate as a key metabolite in the induction of muscle fatigue, American exercise biochemists question its importance and, in contrast, hypothesized that lactate accumulation does not play a central role in fatigue.

This study reveals that Russian and American exercise biochemists hold quite different views on the role of lactate in muscle metabolism and the importance of its role in muscle fatigue. This study makes its conclusions by explicating that discovery of cAMP in the United States have been extended by Ukrainian scientists examining roles of cyclic AMP in muscle function, providing further evidence that information transfer across national boundaries is necessary for the rapid and efficient advancement of Exercise Biochemistry.

#### P12V-09

### Physical exercise and genes polymorphisms in athletes

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**Keywords:** training, T/M genotype, angiotensinogen gene (AGT)

The genetic differences among athletes in adaptive response to exercise could be partly explained through gene-environment interaction. Association of genes polymorphisms with exercise training was not well known. Potential role of vitamin D receptor gene polymorphism to determine exercise training was shown. There are associations of angiotensin-converting enzyme gene (ACE), angiotensinogen gene (AGT), angiotensin II receptor 1 gene (AGT2R1), vitamin D receptor gene (VDR3), endothelial nitric oxide synthase gene (eNOS) polymorphisms with physical performance. Our

research aim was to analyse association of these five genes polymorphisms with exercise training in rowers.

The polymorphisms of five genes ACE (I/D), AGT (M235T), AGT2R1 (A1166C), VDR (Taq), ecNos (27 b. p. tandem repeat) were studied in rowers from Saint-Petersburg (N=56, men). There were 4 selective criterion of rowers: a) for endurance: 1) rowing on "Concept 11" - 12 min, 2) rowing on "Concept 11" - 2 km, 3) bicycle ergometer test - 12 min; b) for power: 4) 10 maximal strokes on "Concept 11". On the basis of each test we found two groups of rowers with high and low characteristics. These individuals provided a mouthwash sample and DNA was extracted from the buccal cells contained in this sample. The polymorphisms of five genes were determined by PCR-RFLP method. Genotype distribution and allele frequencies between groups of athletes and controls were then compared by  $\chi^2$  test.

Distributions of genotypes frequencies of AGT gene were different in high and characteristic groups compared with control for all of tests. Significantly higher frequency of T/M genotype was found in the group of rowers with high characteristics compared to control group for all tests ( $p < 0.01$ ). Rowing on "Concept 11" - 12 min test was shown the following frequencies of T/M genotype for high characteristics athletes - 91%, for low characteristics - 50%, for controls - 31%; rowing on "Concept 11" - 2 km - 80%, 56%, 31% respectively; bicycle ergometer test - 80%, 67%, 31%, respectively; power test - 83%, 55%, 31%, respectively. Others gene polymorphisms were not significantly different in high and low characteristic groups compared to control group for all tests.

Evidently T/M genotype of AGT gene is a marker associated with exercise training in rowers. However, it must not be ruled out that any other genes polymorphisms can influence exercise training.

#### P12V-10

### Effects of diabetes and endurance training on gene expression profiles of mouse heart and skeletal muscle

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**Keywords:** endurance training, diabetes, gene expression

It is well recognized that glucose transport activity and oxidative metabolism of skeletal muscle are markedly reduced in diabetes and similarly well known that these phenomena are enhanced due to exercise training. Correspondingly, diabetes impairs and training ameliorates myocardial function. These consequences are also evident in the pharmacologically induced type 1 diabetes and in exercise-trained experimental animals. We determined gene expression profiles of skeletal muscle and myocardium in order to discover associations in cellular factors that are regulated due to type 1 diabetes, physical training or their combination.

Streptozotocin-induced type 1 diabetic and healthy control mice were divided into training (treadmill training for 1 h/day, 5 d/week) and sedentary groups. Gene expression profiles of the training and respective sedentary mice were determined after 5, 15, and 25 training sessions. Animals were sacrificed 24 hours after the last training session. Total RNA was isolated from the left calf and myocardium and pooled within each group. Gene expression was analysed with Affymetrix GeneChip MG U74Av2 representing 6000 known genes and

6000 EST clusters. Expression data was further processed with Microarray Suite and GeneSpring software.

In skeletal and heart muscles, preliminary analysis of the data showed diabetes-induced changes in 125 and 51 genes, respectively. Combination of diabetes and training decreased the number of affected genes in skeletal muscle and increased in myocardium. Training per se altered the expression of only a few genes. Regulated genes included e.g. enzymes of energy metabolism, structural proteins and members of insulin, G-protein and Ca signalling pathways. K-means and other clustering procedures of expression profiles revealed tightly regulated groups of functionally known and unknown genes.

We have shown that insulin-deficient diabetes results in profound changes in gene expression both in skeletal muscle and myocardium. Training seems to reverse the expression of some but not all genes. This suggests that training may provide protection to metabolic and other cellular abnormalities underlying diabetes. Tight time- and treatment-dependent regulation of genes revealed by expression clustering suggests mechanisms of coordinated regulation of these genes, and gives an opportunity to identify novel genes that are involved in diabetes or training-related cellular functions.

#### P12V-11

### Genotypes of ACE young athletes

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**Keywords:** young athletes, ACE gene

Human physical performance is strongly influenced by the genetic factor. A variation in the structure of the human angiotensin 1-converting enzyme (ACE) gene has been reported in which the insertion (I) variant is associated with lower ACE levels than the deletion (D) gene. We have previously reported that the I variant was associated with improved endurance performance in Russian athletes (Nazarov et al., 2001).

The purpose of this study was to evaluate this genotype distribution in young Russian athletes.

The subjects of this investigation were young athletes - sports college students. One hundred and twenty one healthy students of the sports college (31 girls, age  $17.4 \pm 0.4$  yrs, weight:  $64.3 \pm 1.7$  cm, body mass:  $57.0 \pm 1.4$  kg; 90 boys, age:  $16.2 \pm 0.2$  yrs, weight:  $173 \pm 0.8$  cm, body mass:  $68.0 \pm 1.2$  kg) participated in this study after a written consent was obtained. A control group included 90 healthy volunteers. DNA was extracted from buccal epithelial cells contained in 10 ml of saline mouthwash donated by the subjects. The ACE polymorphism was typed by PCR method using three primers. A  $\chi^2$  test was used to compare the ACE genotype frequencies between groups. We therefore examined genotype distribution of the ACE gene among the young athletes engaged in different sporting activities.

Individual sports did not show any significant excess of the I allele. The limitations in sample size imposed by the nature of the athletes to be studied reduces the number of athletes represented in each of the 10 sporting disciplines and limits the conclusions that can be drawn.

In particular, there may be sports in which endurance is an important but not prime determination of success. In these, any effect of the I allele may be masked in such a small group (Myerson et al., 1999). The results indicated the importance of genetic analysis for selecting young athletes to enter a sport college. The use of genetic methods suggests

great opportunities for realizing the genetic and molecular basis of physical performance and trainability. Such an approach will change the selection of young athletes and the methods of training. It will improve the efficiency of training for athletes at sports colleges.

Myerson S. et al. (1999). *J. Appl. Physiol.* 87: 1313-6

Nazarov I. et al. (2001). *Eur. J. Hum. Genetics* 9: 797-801

#### P12V-12

### Exercise and motor skills performance and subjective feelings during exercise undertaken when drinking a carbohydrate electrolyte solution

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**Keywords:** performance, sport drink, subjective feelings

This study compared exercise performance, whole body motor skills (MS-Test) performance and subjective feelings when drinking two formulations of a carbohydrate electrolyte sports drink (PowerAde, Coca-Cola) with that when drinking plain water.

7 male volunteers completed 3 trials in randomised order. Trials were identical with the exception of the drink consumed: water, PowerAde Formula 1 (6% CHO, 279/290 mosmol/kg, 24 mmol/l Na) or PowerAde Formula 2 (8.2% CHO, 317 mosmol/kg, 24 mmol/l Na). Baseline measures (urine sample, body mass, questionnaire and MS-Test of Welsh et al, 2002) were made prior to drinking 500ml of the test drink then 20min later subjects began the intermittent shuttle running. For this, the subjects ran between two lines 20m apart. In total, four 15min blocks of intermittent shuttle running were completed. Each consisted of ten 90s segments: 3 walking, 1 maximum sprint, 3 jogging, 3 fast running. The questionnaire and MS-Test were repeated on completion of each 15min block before a further 150ml of the test drink was consumed. After the 4th block, subjects started an incremental shuttle run to exhaustion (Ramsbottom et al, 1988).

The distance run ( $P < 0.02$ ) and maximum running speed ( $P < 0.02$ ) were greater when PowerAde was consumed. Over the 60min exercise subjects reported they felt they had less energy ( $P = 0.00$ ) and were less ready to exercise ( $P = 0.05$ ) when water was consumed, but energy ( $P > 0.10$ ) and readiness to exercise ( $P > 0.06$ ) were maintained when PowerAde was consumed. Subjects also reported feeling less motivated to exercise over the hours exercise with water ( $P = 0.02$ ) whilst their motivation was maintained with both PowerAde drinks ( $P > 0.18$ ). In the MS-Test there was a tendency ( $P = 0.07$ ) for subjects to make more errors when only water, in comparison to PowerAde F1 was consumed.

Exercise performance was better when PowerAde was consumed (subjects could run faster and for longer). Subject's feelings of motivation to exercise were maintained over the hour's exercise when PowerAde drinks were provided whilst with water consumption this enthusiasm decreased. In conclusion, therefore, not only do the PowerAde drinks allow a better exercise performance but motivation to exercise is also maintained.

Ramsbottom R et al. (1988). *Brit J Sports Med* 22: 141-144

Welsh RS et al. (2002). *Med Sci Sports Exerc* 34: 723-731

#### P12V-13

### Effects of a prolonged intake of L-arginine-L-aspartate on motor performance

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**Keywords:** motor performance, L-arginine-L-aspartate, ergogenics

L-arginine-L-aspartate is widely used by athletes for its potentially ergogenic properties. It has been reported to increase exercise performance. However, most published studies did not use standardised test procedures, were not controlled, and investigated drug effects only on a restricted scope of performance. Thus, we evaluated the effects of prolonged intake of L-arginine-L-aspartate on a broad spectrum of motor performance.

27 healthy volunteers ( $21 \pm 2$  years) were randomly assigned to the L-arg.-L-asp. group (8 females, 5 males) or to the control group (8 females, 6 males). A daily dose of 1 gram of L-arg.-L-asp. was administered for 3 weeks. Tests of maximum isometric and dynamic muscle strength, aerobic and anaerobic endurance capacity, reaction times, maximum running velocity, and motor coordination were performed before and after the 3-week treatment period. Physical activity was standardised for both groups throughout the study.

All study participants completed the experiment without any problems. Out of all tests carried out only maximum endurance performance on the cycle ergometer tended to be increased and blood lactate concentrations during submaximal work on the ergometer were diminished after 3 weeks of L-arg.-L-asp. compared to control conditions. Blood lactate concentrations at 150 watt declined from pre- to post-tests by  $-0.44 \pm 0.27$  mmol/l after L-arginine-L-aspartate and remained unchanged in the control group ( $0.0 \pm 0.32$  mmol/l) ( $p < 0.01$ ). The accuracy of aim was even slightly reduced in the L-arginine-L-aspartate group ( $-0.59 \pm 0.65$  scores) in comparison to the control group ( $+0.22 \pm 1.1$  scores) ( $p = 0.03$ ).

Because we did not perform a placebo-controlled study these findings must be interpreted with caution. Nevertheless, a right shift of the lactate-performance curve and thus an improvement in aerobic performance may be assumed after prolonged intake of L-arginine-L-aspartate. This is well in accordance with prior findings.

#### P12V-14

### Effect of long-term exercise on skeletal muscle insulin-like growth factor-I (IGF-I) mRNA and circulating IGF-I in rat

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**Keywords:** insulin-like growth factor I, gene expression, wheel running

Insulin-like growth factor-I (IGF-I) is an ubiquitous endocrine, paracrine and autocrine polypeptide which influences cell proliferation and differentiation in many tissues as well as it stimulates muscle protein synthesis. The purpose of the present study was to examine the effect of chronic physical activity on the expression of IGF-I mRNA in skeletal muscle and to correlate these effects with serum IGF-I levels.

Male Wistar rats ( $n = 20$ ) were housed in wheel cages for 12 weeks, while another group ( $n = 9$ ) was housed in plain cages

and remained untrained (UT). Based on daily running distance, the training group was further divided into highly (HT, n=13) and moderately (MT, n=7) trained group. Serum IGF-I was measured after the completion of the 8th and 12th week by enzyme immunoassay. IGF-I mRNA was determined in the gastrocnemius muscle of the six most trained and six untrained rats at the end of the 12th week by quantitative real time RT-PCR analysis.

We found significantly lower serum IGF-I values in the highly and moderately trained animals compared to the untrained ones, both at the 8th and 12th week. In contrast, muscle IGF-I mRNA levels did not differ between trained and untrained rats. Possible explanations for the observed reduction of serum IGF-I levels include the existence of exercise-induced feedback mechanisms involving growth hormone and/or modulations of skeletal muscle IGF-I production. To test the latter hypothesis, we examined the expression of IGF-I in M. gastrocnemius. In contrast to the serum IGF-I levels, IGF-I mRNA in muscle remained unaffected by physical activity. The absence of IGF-I transcriptional modulation in the muscle after a 12-week training could be based on a different time course and pattern of IGF-I regulation, induced by the type and amount of muscular work load we used. However, it is unlikely that modulations in local skeletal muscle IGF-I expression are the source of the observed variations in IGF-I serum levels. The physiological significance of the lowering effect of wheel running on IGF-I concentration in rats serum has to be examined in further investigations.

#### P12V-15

### Stochastic and genetic factors influence age-related locomotors decline in *Drosophila melanogaster*

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**Keywords:** *genetics, drosophila*

It has been suggested that oxidative stress plays a central role on the aging process. Since physical activity induces an increase in oxidative stress, we may ask how it influences

the aging phenomenon. Considering the effects of regular physical activity in retarding human age-related locomotor's decline, it seems important to assess if common features occur in *Drosophila melanogaster* and how it relates to longevity.

Using the model proposed by Mota & Duarte (2001), *Drosophila melanogaster* (Berlin K) were chronically submitted to normal physical activity (NPA) and restricted physical activity (RPA) to measure: longevity parameters (survival rate, ALSP and MLSP); physical activity level changes with age (at 1st, 20th and 50th day of life); and oxidative stress parameters: GSH and GSSG (Tietze, 1969), protein carbonyl groups (Adams et al., 2001) and CAT activity (Aebi, 1984) at the 20th and the 50th day of life.

NPA *Drosophila* had a significant greater ALSP and MLSP compared to RPA group. Locomotion decreased significantly with age in both groups. In each moment, differences in total displacement between groups were significant, being the highest observed in the NPA group. Total glutathione increased significantly in RPA group, between the 20th and the 50th day. At the 20th day, total glutathione, GSSG and GSSG/(GSH+GSSG) ratio were significantly higher in the NPA group comparatively to the RPA group. CAT activity was slightly higher in the NPA group, at both ages. Protein carbonyl groups increased significantly with age in both groups, although no differences between them were observed in either age.

Our analysis of age-related changes in locomotor activity reveals that stochastic factors, as physical activity level, make a significant contribution to aging decline, since the NPA group had a greater longevity than the RPA one. Data reveals that oxidative stress and oxidative damage to protein increase with age. Having in mind the same age for both groups, our results suggest that reactive oxygen values were higher in the NPA group. However, their higher antioxidant capacity seemed to be enough to avoid major homeostasis loss, and so, oxidative damage didn't differ from RPA group. Adams S et al. (2001) *Frontiers in Biosciences*. 6, 17-24.

Aebi H (1984) *Methods in Enzymology*. 105, 121-126.

Mota M, Duarte J. (2001) In J Maia (Ed) *Genética e práticas desportivo-motoras*, 43-63. FCDEF-UP.

Tietze F. (1969) *Anal Biochem*. 27, 502-522.

## Poster Session

### Nutrition 2

### P12W

#### P12W-01

### Carbohydrate-electrolyte ingestion and 1h cycling performance

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**Keywords:** *cycling, performance, carbohydrate electrolyte*

The effects of Carbohydrate-electrolyte (CE) feedings on time trial cycling performance of approximately 1 hour has been investigated with conflicting results. Possible explanations for this include differing performance tests (i.e. time to fatigue vs. time to complete a set task protocols) and/or differing subject dietary standardisation protocols. For instance, Jeukendrup and co-workers demonstrated an improvement in performance with a CE solution of approximately 2% following a self-selected period of high carbohydrate intake during the 24 hours pre-exercise. Because of the uncertainty over the actual pre-exercise

carbohydrate intake it is unclear if the results are a true reflection of the effects of CE feeding during high intensity cycling on athletes that have adequate glycogen stores. Therefore, we conducted a study to investigate the effect of a CE solution on performance when an athlete strictly abides by the guidelines suggested for optimal pre-exercise nutrition. Six well-trained subjects (age: 31.04±3.6 yrs, mass: 73.4±2.03, VO<sub>2peak</sub>: 67.3±1.18) completed a set amount of work as fast as possible (time trial) following 24 hours of tight dietary (subjects were provided with prepared food) and exercise control. Subjects also consumed a carbohydrate based "race breakfast" 2 hours before each trial. During the trials subjects were randomly provided with 14ml/kg of either 6% CE solution or carbohydrate free placebo.

Dietary intake for the preceding 24 hours was Energy = 4.1MJ ±0.06, CHO = 8.98±.19g/kg, and for the race breakfast was CHO = 1.92±.02g/kg. Results showed that the magnitude of improvement in performance was approximately 1.6% (-1.9 - 5.1% 95%CL) whilst consuming

the CE solution ( $59.67 \pm 1.49$  versus  $60.73 \pm 2.06$  min). However, this result failed to reach statistical significance ( $p=0.29$ ).

Analysis of likelihoods of true values (Hopkins [www.sportsci.org](http://www.sportsci.org)) revealed that when taking CE solutions before a 1 hour time trial, the additional carbohydrate was 56% more likely to improve athletic performance, than produce a trivial result (41%), or a negative one (3%). It was concluded that the ingestion of a CE solution during a 1-hour cycling time trial is unlikely to impair performance but the extent to which performance may improve is unclear and warrants further investigation.

Jeukendrup et al (1997). *Int J of Sports Med* 18(2): 125-12

## P12W-02

### A survey of the nutritional condition in Iranian badminton players

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**Keywords:** *badminton, nutrition*

Badminton is a speedy sport that the movement of the players is very much in a small place. Suitable nutrition is one of the most important factors in success of players in the matches. Nutrition plan plus continuous and methodical activities improves the ability of the players. This research has been done during six months for about 12 national team players. This research shows a meaningful relation between nutrition effect and the improvement in sport functions with their successes in the matches.

This research has been done on badminton players in the range of 19-23 years old. Fat mass is the most important factor in this way. Average body fat percent has been determined approximately 10% which depends on the age, sex, race, environmental conditions and genetics. In This research, body fat percent of the players was found about 11-16% in the beginning of the study. After six months and by the diets given by dietitians; body fat percent reduced to 9.6-11.5%.

Grapefruit and grapefruit juice was given in diet. It reduced body fat percent significantly.

Blood pressure of players was in normal range (120/70) and so grapefruit did not cause hypo tension or any other side effect.

Since badminton players are in the risk of dehydration and electrolytes reduction specially potassium, sport drink including two bananas plus one glass of milk was given during exercise. Another drink which was ordered, contains 1/2 glass orange juice, 1/2 tablespoon sugar and 1/4 teaspoon salt. After drinking sport drink, hypo tension, dehydration and heatstroke was removed completely.

It was found that two-three slices of banana-cake increases the exercise ability and heat stork and fatigue was completely removed. Banana-cake is made of banana, milk, grape juice or date juice, whole flour, salt and egg, that nutritional value of banana-cake was 70% carbohydrates, 10% proteins and 20% fat.

1. Using the grapefruit and grapefruit juice will reduce body fat mass of players.
2. Increasing of carbohydrates use by players during the matches will increase the sport ability.
3. Banana-cake can be called as a sport-cake that increases sport endurance.
4. The most important result is that diet and nutrients can affect the sport endurance and also can cause success fullness in the matches.

## P12W-03

### Study of some factors influencing the zinc status

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**Keywords:** *zinc, nutritional intake, blood status*

The purpose of this study was to evaluate the zinc status as function of zinc, dietary fibre, iron and protein intake. Three subgroups were studied and compared: endurance and non-endurance athletes, vegetarians and non-vegetarians, both from an adolescent and young adult population, and elderly vegetarians and non-vegetarians.

The group consisted of 213 subjects (110 men and 103 women: mean age  $39 \pm 26.8$  years; aged 12 - 96.7 years). All subjects completed a food frequency questionnaire or a 7-days food diary in order to estimate nutritional intake. A venous blood sample was collected in order to determine the blood zinc status.

Endurance athletes ( $n=32$ ) and non-endurance athletes ( $n=30$ ): The non-endurance athletes did not meet the requirements for zinc (48% of the RDA). The low zinc intake did not result in an inadequate blood zinc status. No significant correlation was found between the blood zinc status and the intake of zinc, calcium, iron, protein and dietary fibre, respectively.

Vegetarian ( $n=60$ ) and non-vegetarian ( $n=50$ ) adolescents and young adults. The zinc intake was far too low amongst vegetarians ( $4.7 \pm 2.2$  mg/day) and non-vegetarians ( $7.1 \pm 4.2$  mg/day). The intake was significantly higher for the non-vegetarians compared to the vegetarians ( $p<0.05$ ). Although the zinc intake was lower in the vegetarian group, their blood zinc status was higher than in the non-vegetarian group. In both groups no significant correlation was found between the zinc intake and the blood zinc status. None of the investigated parameters showed a significant correlation with the blood zinc status.

Vegetarian ( $n=25$ ) and non-vegetarian elderly ( $n=26$ )

The zinc intake in vegetarian and non-vegetarian elderly was respectively 76% and 80.6% of the RDA. These low intake values were reflected by a very low blood zinc status ( $64.5 \pm 12$  µg/dl for the non-vegetarians and  $63 \pm 14$  µg/dl for the vegetarians; lower limit 70 µg/dl).

Except for the elderly all groups met the recommended blood zinc status (70-150µg/dl). Since the zinc intake for the elderly was higher compared to all other groups we may assume that the low zinc status is probably due to physiological changes in the elderly. No significant correlation was found between the food intake (zinc, calcium, iron, protein and dietary fibre) and the blood zinc status.

## P12W-04

### Macronutrient oxidation during exercise following two weeks of L-Carnitine L-Tartrate supplementation

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**Keywords:** *cycling, endurance, metabolism*

L-Carnitine supplementation has been proposed to enhance fat oxidation during exercise, however, it may also allow more complete oxidation of carbohydrate (CHO) and increased oxidation of branched-chain amino acids (BCAA)(2).

We have previously observed, in two studies of endurance-trained males using indirect calorimetry, an enhanced CHO

oxidation during 60 and 90mins cycling exercise following 2 wks supplementation with 3g L-Carnipure® L-Carnitine L-Tartrate (LCLT, 2g L-Carnitine)/day [mean(±SD), 78.2(23.3)g placebo vs 93.8(17.3)g LCLT over 60mins (1),  $p=0.02$ ; 107(33)g pre LCLT vs 135(27)g 2wks LCLT over 90mins (unpublished data),  $p=0.01$ ]. The aim of the present study was to determine whether any change in protein oxidation occurs during exercise following 2 wks supplementation with 3g/day of LCLT. 20 male cyclists (means 33yrs, 178cm, 76kg, 4.9L VO<sub>2</sub>max) were pair-matched and randomly assigned to placebo (P) or LCLT supplementation for 2 wks in a double-blind manner. Two capsules were taken twice daily, with meals. Subjects consumed a prescribed diet 48hrs prior to and 24hrs following each trial, and maintained consistent training. During the exercise trials, subjects cycled for 90mins on an electrically braked cycle ergometer at 60% of power achieved at VO<sub>2</sub>max (mean 224W). Expired gases were measured every 15mins during exercise, and urine samples collected 24hrs pre- and 24hrs post-exercise for assessment of urinary nitrogen excretion.

There was no difference in CHO ( $p=0.38$ ) or fat ( $p=0.40$ ) oxidation pre to post P, nor pre to post LCLT (CHO  $p=0.27$  and fat  $p=0.15$ ,  $n=10$ ). There was no difference in pre and post exercise urinary nitrogen excretion between baseline and 2 wks for either P (range 15.5-19.2g,  $p=0.69$  pre 24hr and  $p=0.22$  post 24hr) or LCLT (range 15.4-16.8g,  $p=0.48$  pre 24hr and  $p=0.61$  post 24hr).

Our preliminary findings indicate that 2 wks oral supplementation with LCLT does not appear to increase protein oxidation during endurance exercise. However, other analyses including urinary carnitine and trimethylamine excretion are being undertaken to clarify this further.

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## P12W-05

### Nutritional assessment of Brazilian amputee soccer players

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**Keywords:** soccer, disabled athletes, nutritional assessment

Soccer is one of the most popular sports in the world, especially in Brazil, but, the amputee's soccer is still unknown by the public in general. The game requires an increase in the metabolic demand and with the amputation of lower limbs, the energy cost of walking and running can increase dramatically. Thus, the nutritional aspect plays an important role in the athletic performance and quality of life.

The aim of the study is to determine the nutritional status of four amputees soccer players aged from 21 to 33 years old, and members of the Brazilian Amputee Soccer Team. Data of the dietary intake was analysed using the six-day food records for macronutrients (carbohydrate, protein and fat) and to iron and calcium. To the anthropometric evaluation were measured weight, height, and the sum of four skinfold (triceps, abdominal, thigh and thoracic). The biochemical analyses occurred with the dosage of hemoglobin, hematocrit, ferritin and transferrin to analyse the iron status; urea, creatine and albumin to value the protein status and the lipid status with the dosage of total cholesterol and fractions and triglycerides.

The results showed that the mean total energy intake ( $1390 \pm 552.11$  kcal), carbohydrate ( $51.71 \pm 7.12\%$ ) and protein ( $1.21 \pm 0.43$ g PTN/ kg), did not reach the recommendations for athletes, like the micronutrient calcium ( $410.29 \pm 210.86$  mg) which is very important to the bone content of the overloaded resting leg. The anthropometric analyses were collected to feature the amputees athletes because there are no parameters to compare caused by the lack of literature in this area. The biochemical analyses showed no iron deficiency, no protein catabolism and good lipid status. Although there were no clinical evidences of nutritional deficiencies, the athletes show a dietary intake on the side of their recommendations that can influence the physical performance.

This results highlights the importance of the individualized nutritional monitoring for athletes, specially disabled ones; and that although the known importance of the nutrition to detect, prevent and even treat any nutritional deficiency and to improve performance, the literature about nutritional assessment of handicapped athlete's are scarce, what shows that more studies are needed.

## P12W-06

### The effects of carbohydrate/electrolyte drink ingestion on maintenance of skill in squash players

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**Keywords:** skills, carbohydrate, squash

The purpose of the present work was to examine the effects of carbohydrate/electrolyte drink (CED) ingestion on performance in a squash skill test, following short duration high-intensity exercise.

Ten male National League Division 1 squash players were recruited. The subjects attended on three occasions, in which they performed a skill test (PreST), treadmill running for 20 minutes, 9 minutes of high-intensity on-court ghosting, and a final skill test (PostST). The first visit was a familiarisation session and the two subsequent visits involved ingestion of 1L of either a lemon flavoured CED (Lucozade Sport, GlaxoSmithKline) or placebo (low calorie lemon juice) in a single blind cross-over design. On the study days, after a standardised warm-up, the subject completed a 120 shot (60 forehand and 60 backhand) boast and drive routine for skill assessment (PreST). Scoring of the skill test related to line and length of the shot with 3, 2, 1 and 0 point scoring zones. Following a 2-minute rest interval for fixed volume fluid ingestion (333ml) the subject completed a 20-minute treadmill run at 80% maximum heart rate, a 2-minute rest with fluid ingestion (333 ml), and then a 9-minute high-intensity on-court ghosting routine. After a further 2-minute rest with fluid ingestion (333 ml) the subject completed the same initial 120 shot skill test (PostST). Heart rate was recorded during the treadmill running and ghosting routine. A basic performance and feel questionnaire (1-10 Likert scale) was administered to obtain a subjective analysis of performance after PostST.

The mean (SD) scores on PreST were not different between trials (141(16) vs. 140(18);  $p=0.79$  for CED and placebo trials, respectively). There was no difference in heart rate during treadmill running (157(3) vs. 157(3)) and ghosting (175(5) vs. 175(5)) on CED and placebo trials, respectively. There was a significantly better PostST total score (110(15) vs. 94(20);  $p=0.03$ ) in the CED trial than with placebo, and this was due to a lower number of zero's scored (57(9) vs. 69(9);  $p=0.01$ ) in the CED trial than with placebo. In the performance and feel questionnaire there was a tendency for

subjects to indicate better on-court positioning relative to the ball (6.7(0.9) vs. 5.9(1.4)  $p=0.05$ ) in the CED trial compared with placebo trial.

The data from the present study suggest that CED ingestion improves skill retention in squash players, and this preliminary finding warrants further investigation.

#### P12W-07

### Antioxidant capacity and lipid peroxidation: effect of aerobic training associated with hypoxic exposition during sleep

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*Keywords: training, antioxidative capacity, hypoxia*

The aim of this study was to determine, on high-level Nordic skiers, the impact of physical training associated with hypoxia during sleep on the oxidative stress markers and the antioxidant capacity: 1) at rest and 2) on the response to an acute hypoxic exercise.

Eleven subjects were divided in 2 groups: one group (H) (n=6) trained at low altitude (1,100 m) and slept in a normobaric hypoxic room during 3 weeks: simulating 2,500 m during the first week, 3,000 m the second week and 3,500 m the third week; the second group (N) (n=5) was submitted the same training but slept at 1,100 m of altitude.

Venous blood samples were collected in pre-training state (I), immediately at the end of training session (II) and 2 weeks after (III). Plasma Trolox equivalent antioxidant capacity (TEAC) and TBARS (Thiobarbituric acid reactive substances) were measured before and after a 10 min cycling exercise (30 % of  $VO_{2max}$ ) at a simulated altitude of 4,800 m in I and III and only at rest in II.

Resting TEAC were decreased by training (I vs II) in both groups (H = - 21 %,  $p = 0.03$ , N = - 13 %,  $p = 0.04$  without significance between H and N) and returned to his basal value in III. Acute hypoxic tests had no effect regardless of groups and periods. For lipid peroxidation, only the acute hypoxic test increased TBARS in III for H (+ 18 %,  $p = 0.02$ ). These findings demonstrated that an intense aerobic training was responsible for a decrease in antioxidant capacity and emphasized the lipid peroxidation when the training was associated to a hypoxic exposition during sleep. An improvement of antioxidant defences could be a strategy to protect the health of athletes submitted to this type of training.

#### P12W-08

### The influence of high carbohydrate meals with different glycaemic indices on substrate utilisation during subsequent exercise

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*Keywords: glycaemic index, submaximal exercise, substrate utilisation*

The study was designed to examine the effects of mixed high carbohydrate meals with different glycaemic indices on substrate utilization during subsequent exercise.

Six healthy male recreational runners (age:  $27 \pm 1.6$  yrs; body mass:  $75.1 \pm 3.5$  kg;  $57.2 \pm 2.4$  ml.kg<sup>-1</sup>.min<sup>-1</sup>) (mean $\pm$ SEM) completed three trials, which were high glycaemic index meal (HGI), low glycaemic index meal (LGI) and fasting (FAST),

separated by 7 days. The test meals contained 2g.kg<sup>-1</sup> body mass of carbohydrate which were isocaloric in content and the glycaemic index (GI) values were 77.4, 36.9 and 0 respectively. In each trial, subjects consumed the test meal 3 hours before performing a 60 min run at 65% on a motorized treadmill.

Ingestion of the HGI and LGI resulted in hyperglycaemia and hyperinsulinaemia during the postprandial period compared to the FAST ( $p < 0.05$ ). The incremental area under the curve for plasma glucose was two-fold higher in the HGI compared to that of the LGI trial (119.8 mmol.l<sup>-1</sup>.min<sup>-1</sup> v.s. 56.4 mmol.l<sup>-1</sup>.min<sup>-1</sup>). In contrast, plasma free fatty acid concentrations were significantly depressed following HGI and LGI compared to FAST ( $p < 0.05$ ). During the subsequent submaximal exercise, plasma glucose declined to below the fasting value in HGI compared to that of LGI and FAST trials ( $p < 0.05$ ). The estimated total fat oxidation was significantly higher in the LGI than the HGI trial during exercise ( $p < 0.05$ ). In summary, the ingestion of a mixed low glycaemic index meal 3 h before exercise induced higher fat oxidation during subsequent exercise, which may spare muscle glycogen during exercise and be of potential benefit in terms of decreasing body fat mass in man.

#### P12W-09

### The use of sports nutrition and vitamins in youth sport (questioning results)

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*Keywords: young athletes, nutrition, vitamins*

The intensification of the training process results in higher needs of young sportsmen in macro- and micronutrients and energy. However, the normal nutrition products currently do not meet the sportsmen's daily energy input and the respective expenditure of plastic material (Tutelyan V., 2000). For that reason it is desirable and possible to use special sport-nutrition products during practice in youth sport, with mandatory inclusion of vitamin preparations in the dietary intake of young sportsmen. The purpose of this work was to study specific features of the use of sport nutrition products and vitamin preparations in youth sport and the assessment of their effect.

The subjects were young sportsmen aged 12-18 taking physical exercise regularly in youth sport sections and schools. 345 sportsmen were questioned. The respondents were asked to answer 22 questions.

The analysis of collected data showed that the consumption of sport nutrition products increases with the age of sportsmen, with the growth of sporting qualification, the length of exercise of the particular sport and the training load.

The sportsmen themselves give the following reasons for not using the sport nutrition: 64 % claim that they do not see the need for it; 19,4% refer to a lack of information; 12 % give the reasons of material standing character.

The source of information for sportsmen using sport nutrition is mostly the coach, next the parents and then the sports-medicine doctor. The second group of sportsmen refers to their mates in the first place followed subsequently by the coach, the parents and the sports literature.

The predominantly wrong tactics for the intake of vitamin complexes by a group of sportsmen not using sport nutrition products shows the low level of their awareness with respect to the referred issue.

Summing up it is necessary to note that at the early period of work with sportsmen the issues concerning rehabilitation measures, including the consumption of sport nutrition



products and vitamins, must have a pedagogically useful solution.

Tutelyan V., Knygev V. J (2000). *Question of nutrition* 69 (3):4-7.

#### P12W-10

### Nutritional assessment of a group of handicapped individuals involved in physical activity program

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**Keywords:** *physical activity, nutritional assessment, handicapped*

Physical activity practice for handicapped individuals gives physical and psychological benefits. However, when it is preceded to the nutritional assessment of these individuals, we observe the absence of reference standards, or normality parameters.

The aim is to describe the nutritional profile of a group of handicapped individuals involved in a physical activity program, comparing with the existing reference standards.

68 handicapped individuals involved in physical activity had been studied. The causes of the deficiencies was: spinal cord injury (SCI) and poliomyelitis (P). The nutritional assessment consisted of: 24h food recall; weight, height estimative and body composition by DEXA (dual-energy X-ray absorptiometry); serum total cholesterol, LDL, HDL and triglycerides.

The energy ingestion was below to the recommendations, and wrong energetic distribution by the macronutrients. The analysis of the body composition showed high percentage of fat and a lean mass diminished, and a light reduction in bone density. The bone mass reduction was very pronounced in the legs. There are no significant alterations in the serum lipids, in spite of literature data. Still, even so has been found high percentage of body fat, the serum lipids had not been correlated with this data.

The high percentage of body fat indicates low metabolic activity, confirmed for the low energy ingestion. The high percentage of body fat cannot be a pointer of cardiovascular diseases. It is necessary to develop standards for bone density and body fat in the group.

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#### P12W-11

### Nutritional habits, biometrical characteristics and physical performance capacity in children aged 4-12 years

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**Keywords:** *physical performance, children, nutritional habits*

It was the aim of the present study to re-investigate the nutritional habits of children (aged 4-12 years) in combination with an evaluation of their morphological characteristics and their physical performance capacity.

Volunteers were recruited in different Flemish schools around Brussels. Nutritional intake was evaluated using a 3-days food questionnaire. Physical performance capacity was assessed using the Eurofit testbattery. The anthropometric measurements included weight, height, triceps, suprailiac,

subscapular and calf skinfold thickness and perimeters of the upper arm, calf and bicondylar femur and humerus width.

162 girls and 142 boys participated in the practical part of the experiments. In the age group 4 to 6 we did not differentiate between girls and boys. The age groups 7 to 9 and 10 to 12 were separated in girls and boys.

Only 157 food questionnaires could be used for analysis (92 girls and 65 boys). Energy intake was sufficient for all age groups except for the oldest groups with an intake of  $6823 \pm 1595$  kJ for the girls (reference 8900 kJ) and  $7513 \pm 1828$  kJ (reference 9500 kJ) for the boys. Carbohydrate intake was too low while protein and saturated fat intake were too high. The low Ca intake and the high P intake resulted in a very low Ca/P ratio for all age groups. Zn intake was too low for all age groups.

When comparing with reference data (Beunen et al, 1991) performance capacity decreased for most of the groups for the following tests: standing broad jump, 30 sec sit-up test, bent arms hanging and the Légier test. For the other tests we found no significant differences.

The anthropometric measurements indicated a decrease in body height and a similar body weight when comparing with the reference data, resulting in a significant higher BMI. All age groups were found to be mesomorph only the boys aged 10-12 showed an endo-mesomorph somatotype.

Nutritional habits did not improve when comparing with the results of De Vuyst et al (1990). Physical performance capacity decreased while the BMI increased when comparing with the reference data of 1991.

#### P12W-12

### Effects of creatine supplementation on anaerobic performance in Wingate Test

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**Keywords:** *Wingate test, creatine supplementation, anaerobic performance*

In the last years creatine supplementation was used as an ergogenic resource, mainly by athletes in modalities which involve efforts of high-intensity and short duration, with the objective of improving their results (Hultman et al., 1996). However, the effects of acute creatine supplementation on this type of task still cause controversy (Green et al., 2001; Snow et al., 1998). Thus, the objective of this study was to verify the effects of 5 days of creatine supplementation on physical performance in the Wingate Test.

The sample was composed by 22 healthy individuals ( $23.5 \pm 2.91$  years) involved in a weight training program. The subjects were supplemented with creatine (CR;  $n = 11$ ; body mass  $77.6 \pm 11.8$  kg; height  $181.0 \pm 6.8$  cm; BMI  $23.7 \pm 3.7$  kg/m<sup>2</sup>) or Placebo (maltodextrin) (PL;  $n = 11$ ; body mass  $74.7 \pm 10.4$  kg; height  $177.0 \pm 9.2$  cm; BMI  $23.8 \pm 2.3$  kg/m<sup>2</sup>) during 5 days (4 doses of 5.2 g = 20.8 g/day), using a double blind procedure. The Wingate Test was used to evaluate anaerobic performance, adopting load corresponding to 9 g/Kg of the subject's body mass. The Wingate Test was applied one day before the beginning of the supplementation and 6 days after the beginning of the supplementation. The analysis performance indexes were Relative Peak Power (RPP) and Relative Mean Power (RMP). For statistical treatment of RPP and RMP the repeated measures analysis of covariance (ANCOVA) and the repeated measures analysis of variance (ANOVA) were used, respectively. When

differences by ANOVA or ANCOVA were found the Tukey post hoc test was employed ( $P < 0.05$ ).

After supplementation the CR group increased its performance in RMP ( $8.9 \pm 0.7$  vs  $9.3 \pm 0.7$ ;  $P < 0.05$ ) with no changes in RPP ( $12.17 \pm 0.84$  vs  $12.7 \pm 0.9$ ;  $P > 0.05$ ). On the other hand, the PL group did not present changes in either of the analyzed indexes (RPP -  $11.6 \pm 0.9$  vs  $11.8 \pm 0.9$ ; RMP -  $8.9 \pm 0.50$  vs  $8.8 \pm 0.4$ ;  $P > 0.05$ ).

From the results we may conclude that creatine supplementation has demonstrated to be an efficient ergogenic resource in activities of high-intensity and short duration, and mainly in the capacity of supporting this effort.

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Snow R J et al (1998). *J. Appl. Physiol.* 84:1667-73

Green JM et al (2001). *J. Strength Cond. Res.* 15:36-41

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### P12W-13

#### Influence of weight reduction on specific performance in judokas

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**Keywords:** judo, nutritional intake, weight reduction

Fast reduction in body weight is often used before judo competition. Such a reduction may lead to a decrease in physical performance capacity.

Twentytwo judokas were tested before and after weight reduction up to competition weight. The volunteers were asked to use their own method without giving time limitations or instructions for the weight reduction period. Body weight was measured before and after weight reduction. The percentage of body fat was determined on the two occasions by different methods: (1) calculated using skin folds measurements and Lohmans equation, (2) measured by bio electrical impedance with respectively the foot-foot method and the hand-hand method. Food intake before and during the weight reduction period was calculated. Reaction time was measured by means of a jump test using the Optojump system (Microgate - Optojump). Isometric arm strength was measured by tensiometry using the following procedure: determination of the maximum isometric strength, fixing at 60% of the maximum isometric strength during 10 seconds, maximal effort during 3 s, 60% during 7 s, maximal effort during 3s, 60% during 7 s, finishing with a maximal effort during 10 s. Anaerobic endurance was estimated by 5 series of 20 jumps interspersed with 1 min rest intervals. Jumping height was calculated using the Optojump software.

Body weight was significantly reduced when comparing pre and post weight reduction values ( $69.3 \pm 10.7$  kg versus  $67.3 \pm 10.1$  kg), ( $p < 0.01$ ). As indicated by the different measuring methods the percentage of body fat decreased significantly ( $p < 0.01$ ) after weight reduction. Daily energy intake differed significantly ( $p < 0.01$ ) when comparing normal intake ( $2778 \pm 1450$  kcal) with energy intake during the weight reduction period ( $897 \pm 553$  kcal). Only the isometric strength measured during the 3rd maximal effort decreased significantly after weight reduction ( $p = 0.047$ ). Jump performance (jump height, contact time) and heart rate as measured during the anaerobic endurance test were not influenced by weight reduction.

The subjects were able to decrease body weight and percentage of body fat. Only isometric strength was influenced negatively after weight reduction.

### P12W-14

#### Effect of the acute carbohydrate ingestion on performance in high-intensity continuous aerobic exercise

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**Keywords:** cycling, carbohydrate ingestion, aerobic exercise

Carbohydrate (CHO) ingestion before, during and after physical exercise has demonstrated to be efficient for the improvement of physical performance and for the acceleration in the recovering process post-effort (Coombes & Hamilton, 2000). However, there are many doubts in relation to the use of CHO before high-intensity and short duration aerobic exercises, with some studies pointing the maintenance or, even the reduction in physical performance after the ingestion of CHO (Bonen et al., 1981; Koivisto et al., 1981). The purpose of this study was to investigate the effect of the acute ingestion of CHO on performance in high-intensity and short duration continuous aerobic exercise.

Six amateur male cyclists ( $28.7 \pm 9.3$  years; body mass  $66.3 \pm 4.1$  kg; height  $170.0 \pm 6.3$  cm and  $VO_{2max}$   $57.0 \pm 5.0$  ml.kg<sup>-1</sup>.min<sup>-1</sup>) performed continuous test at 80% of load in maximum oxygen consumption ( $W_{vo2max}$ ) in two different situations, after fractionate ingestion of carbohydrate (CHO) or placebo (PL), administrated in a rate of 0.5 g.kg<sup>-1</sup> at 60, 45 and 30 minutes before the beginning of each test. The subjects performed tests with an interval of 72 h between each test, randomized and double blinded. Blood samples were collected immediately before and after effort for glucose, insulin, cortisol and lactate determination. The Student's t-tests were used to compare exhaustion time between CHO and PL conditions, while VE,  $VO_2$ , R, HR, lactate, glucose, insulin, and cortisol used two-way repeated measures analysis of variance (ANOVA).

Exhaustion time at CHO condition was significantly lower (8%) than PL condition ( $15.5 \pm 1.9$  vs  $16.8 \pm 2.2$  min,  $P < 0.01$ ). No differences were observed in  $VO_2$ , VE, HR in comparison to CHO and PL conditions ( $P > 0.05$ ). Significant differences were observed in pre and post-effort at R with elevated values at CHO condition ( $P < 0.001$ ). Pre-exercise blood glucose was significantly higher at CHO condition than PL ( $8.2 \pm 1.0$  vs  $4.9 \pm 0.7$  mmol.l<sup>-1</sup>,  $P < 0.001$ ), as well as insulin levels ( $44.6 \pm 7.4$  vs  $12.7 \pm 9.2$  U/ml,  $P < 0.01$ ). Blood lactate and plasmatic cortisol didn't show any significant alterations in the comparison between the treatments ( $P > 0.05$ ).

We suggest that the ingestion of CHO before the beginning of the test seemed to lower the performance in high-intensity and short duration continuous aerobic exercise.

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Koivisto V A et al (1981). *J. Appl. Physiol.* 51:783-87

Coombes J F, Hamilton K L (2000). *Sports Med.* 29: 181-209

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P12W-15

**Dietary practices of male soccer players from three different levels of competition****Calixto Filomena, Nuno Loureiro, Franco Cláudio**

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*Keywords: soccer, nutrition, diet*

Soccer players, like all athletes, require a well balanced diet with adequate nutrients and energy intake for the demands of daily activities, training and competitions. We have analysed the dietary practices concerning ingestion of energetic nutrients (carbohydrates, lipids and proteins), vitamins (vit. A, B1, B2, B6, and C), minerals (calcium, Ca; phosphorous, P; sodium, Na; potassium, K and iron, Fe) and liquids of 83 soccer male senior players from three different levels of competition, named First League, Second and Third Division. One-day inquiries were applied during day training in the last weeks of the 2002 competition period. Results were analysed comparing the three different categories of teams level, professional and non-professional soccer players and positions occupied in the field.

Energy intakes were not significantly different (t students test,  $p < 0.05$ ) for all the groups analysed, than the estimated for the requirements of soccer players (1), except for the goalkeepers, which was lower and total food intakes were significantly lower, except for the forwards, which was higher. Soccer players from all groups studied ingest, significantly (t students test,  $p < 0.05$ ) more proteins and lipids and less carbohydrates than the recommended (1). There was a difference between the minerals intake of soccer players from the First League and the players from Second and Third Division, although professional and non-professional soccer players consumed poor sources of all minerals studied. There were differences in the mineral content in the diets of soccer players according to their position occupied in the field. In general, the diet of all groups of soccer players studied was poor concerning vit. A, B2 and C, while reached or even exceeded the amounts recommended (1) for vit. B1 and B6. The total liquid ingested was significantly (t students test,  $p < 0.05$ ) lower, for all groups analysed, than the recommended (1), except for the forwards.

Regarding that the end of the season is a particularly important period concerning nutrients intake, soccer players nutritional behaviour shows that nutritional assessment and counselling is required to afford the players an adequate nutrient supply in order to fulfil the demands of their daily activities, training and competitions.

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## ECSS Plenary Debate

## Physical Activity and Health - What is the evidence?

PD12H

## PD12H-1

## Health, genes and exercise

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*Keywords: physical exercise, cardiovascular disease, mortality*

Today there is epidemiological evidence that both a physical active life as well as fitness protects against cardiovascular diseases, diabetes, colon cancer and all cause mortality.

Physical exercise has been shown to be as efficient as conventional medical treatment in lowering blood pressure and in improving the lipid profile and to be twice as effective as oral anti-diabetes treatment in preventing diabetes in individuals with insulin resistance.

Today, evidence also exists that physical training decreases the mortality rate in patients with ischemic heart and heart insufficiency, improves symptoms in patients chronic lung diseases and peripheral arterial insufficiency and that even highly fragile patients benefit from physical training. Indeed, physical inactivity is more dangerous than over-weight – in fact, physical inactivity is as dangerous as smoking. Physical inactivity should be viewed as an independent risk factor for health.

In the past, the role of physical activity has been to view it as a tool to balance calory intake. Although, it is important to avoid obesity, it is much too narrow to only discuss physical inactivity in such a context. Today, we can provide the mechanistic explanation, why exercise has an independent role and can reduce the risk when obese. The explanation is in the genes! Whereas there is not much to do about the genes, one has inherited, the individual has an impact on whether these genes are activated or not. A gene needs to turn into a protein in order to function. Interestingly, several metabolic genes, which are involved in the protection against disease, are activated by muscle contractions, e.g. LPS which is involved in lipid metabolism and GLUT4, which is involved in glucose uptake. Recently, it has also been shown that important transcription factors such as PGC-1 is up-regulated by muscle contractions. IL-6 represents a gene in the muscle, which is totally silent at rest, but is activated only when the muscles are contracting. IL-6 is released into the circulation and exerts its effect as a hormone, inducing lipolysis and inhibition of inflammation. Recent evidence exists that also genes (e.g. PPARgamma) in adipose subcutaneous tissue are activated by leg muscle contractions. Thus, even moderate muscle contractions induce gene activation, which can not be obtained by calory restriction alone, explaining the health beneficial effects of a physical active life.

## PD12H-2

## Evolutionary health promotion

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*Keywords: physical activity, nutrition, evolutionary medicine*

A large amonut of evidence strongly supports that physical activity is associated with decreased risk of chronic deseases. However, the required intensity of activity and the presence of lifestyle confounders are a matter of debate. An evolutionary perspective may be helpful.

Evolutionary health promotion is based on the proposal that typical lifestyles of our paleolithic ancestors (1,500,000 - 10,000 BP) might serve as a model for prevention research and even as a paradigm for lifestyle advice. The human genome was selected in past environments far different from those of the present. Cultural evolution now proceeds too rapidly for genetic accommodation--resulting in dissociation between our genes and our lives. This mismatch between biology and lifestyle fosters development of degenerative diseases.

Through nearly all of human evolution physical exertion and food procurement have been inextricably linked. Prior to the industrial era humans are estimated to have expended a total of about 3000 kcal (12 MJ) daily; for current affluent populations comparable estimates are 2000 kcal (8 MJ) or less. This change has resulted from decreased energy expenditure through physical exertion: about 20 kcal/kg/day (84 kJ) hunter-gatherers versus 5 kcal/kg/day (21 kJ) for sedentary Westerners-a fourfold differential. However, our own observations in the Kitavans of Papua New Guinea suggest that many traditional populations have lower leves of physical activity.

Non-sedentary westerners may need to consider that their diet often differs dramatically from that of our paleolithic ancestors. The latter consists of lean meat, fish, vegetables, fruits, nuts, insects etc. This and other evidence suggest that avoiding dairy products, margarine, oils, refined sugar and cereals, which provide 70% or more of the dietary intake in Sweden, may be advisable. Atherosclerosis, a regular phenomenon in westernized populations, is highly dependent on dietary manipulation in animal experiments. Atherogenic dietary factors include fat (any type) and casein, and hypothetically cereals.

In conclusion, stroke, ischaemic heart disease and type 2 diabetes seem largely preventable by way of lifestyle changes in a paleolithic direction. In addition, insulin resistance, that may have far-reaching clinical implications as a cause of unregulated tissue growth, would hypothetically respond to an ancestral way of life.

## Abstracts without Presentation

ABS

### ABS-01

#### "Motor/Sports activity for health" - presentation of target developmental project

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*Keywords: health, motor activity, promotion strategy*

Physical activity is extremely important to the preservation and the strengthening of the physical, mental, spiritual and social health, as well as to the improvement of the already damaged health. Today, people engage less in physical exercise than it was customary in the past. Physical labour occurs rarely. The technological progress from electrification to automation has led to new era and a more comfortable life, but at the same time it is the main reason for less physical exercise. A passive lifestyle is related to different health, social and economical problems.

The level of physical activities is in Slovenia also low and the problems, which result from that (the frequency of coronary diseases and the risk factors, economical expenses of the medical treatment and the absenteeism from work, a large share of the elderly, dependent population), are big enough, that national intervention is required. The basic information that allows planning is the analysis of the present state. The actual state must be estimated before a design of quality plans for the promotion of the meaning of motor/sports activities for health as well as programmes for motor/sports activities for people to join. The analysis of the actual state, based on a systematic examination of a representative sample and objective indices, will allow us to determine the medical and motor status of children, adolescent and adult inhabitants of Slovenia, thus to identify the key arguments for strategic changes in the motor/sports activity for health. We expect to contribute to the development of the quality of life of the Slovenians by the realization of objectives that follow one another hierarchically from the analysis of the present situation to the evaluation of the possibilities for a quality promotion and realization of motor/sports activity programmes.

Beunen G et al (1992). *Medicine and science in sports and exercise*, 24: 576-585

Malina R, Bouchard C (1991). *Growth, Maturation and Physical activity. Human Kinetics*

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### ABS-02

#### A comparative study of heart rate indices in Ramadan fasting and non-fasting states in elite runners

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*Keywords: heart rate, elite athletes, Ramadan fasting*

Muslims throughout the world fast during Ramadan to fulfill a religious obligation. Fast observers abstain from eating

and drinking between dawn and sunset for the whole month of Ramadan, which is the 9th month of the lunar calendar.

The purpose of our research was the study of changes in four heart rate indices including morning heart rate, night heart rate, recovery heart rate, and lactate threshold heart rate in eight runners of Islamic Republic of Iran's National Team of long-distance and middle-distance running during fasting in the month of Ramadan in comparison to the non-fasting state. During the study, two subjects withdrew due to methodological limits. Morning heart rate & night heart rate was measured using Janssen method. Also, recovery heart rate and lactate threshold heart rate was studied using Orthostatic heart rate method and Conconi's protocol, respectively. Non-fasting measurements were made in seven days before Ramadan, and fasting measurements in the third week of this month. Then, means of fasting and non-fasting values were compared and differences between them were assessed by T student method. There was no significant difference in all variables ( $p > 0.99$ ,  $df=5$ ).

One of the most important questions among Muslim Athletes and coaches is about possible detrimental effects of Ramadan fasting on sport performance. Some people relate this issue to glycogen stores depletion due to meals restrictions in this month. On the other hand, heart rate indices have a strong correlation with aerobic performance. However, in this study, no significant changes were found in the indices. But, it is better to investigate Ramadan fasting effects on performance in hot Ramadan months.

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### ABS-03

#### Adaptation abilities to the sport effort in an orienteering runner

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*Keywords: testing, individuality*

Physical effort, which is a basic element of sport training, creates some functional changes and they, after a longer period, can result in the adaptation to physical effort which is described as physical efficiency or good shape. These changes occur fast or slowly, depending on training impulse and individual abilities to physical work.

Orienteering run is a typical endurance sport, where effort lasts from 60 to 90 minutes. During that time the heart-rate reaches 90% of maximum value, and lactate concentration in blood reaches 4mmol/l. Therefore, if we want to assess the effectiveness of training tasks implementation and preparation to contest, we should continuously watch the development of adaptation changes based on physiological indexes.

The purpose of this examination was to assess the aerobic efficiency of an orienteering runner (aged 19), who is a holder of champion sport class, on the ground of

physiological index changes which are recognised as the manifestation of a body adaptation under influence of training during a two-year practice. The effort test on the mechanical track, with increasing speed of: 12, 14, 16, 18, 20, 22, 24km/h, was used. Duration of the run, at a constant speed, was 5min. Owing to this we were able to observe, at each increased speed, so called steady-state. Therefore the anaerobic threshold for lactic acid concentration, equal to 4mmol/l in blood, was estimated. During the test, the physiological measurements (lungs ventilation, oxygen uptake, heart-rate) were being carried out, and during the one-minute rest breaks, blood from a finger tip was taken in order to determine the lactate concentration (dr Lange's kit). Heart-rate and RQ were recorded.

The indexes show high level of adaptation of the examined competitor, during particular seasons of the year and many-years training cycle. This confirmed by higher speed of running, lower threshold heart-rate, higher percentage of the oxygen volume in comparison to its maximum value.

#### ABS-04

### **Anthropometric characteristic and body composition in elite male team handball players**

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*Keywords: body composition, anthropometry, somatotype*

The anthropometric characteristics of athletes affect performance level and refer to suitable somatotype in each sport. The analysis of these characteristics gives information about the trends that prevail in high performance athletes. The aim of this study was the evaluation of body composition and somatotype characteristics of high performance Greek male handball players.

Sixteen handball players of mens national Greek team [age 25.9 (4.1) yrs], participated in this study. Height and body mass were measured, whereas body mass index and height weight ratio was calculated for all subjects. Body density was calculated using the equation of Durnin & Womersley (1974). Percent body fat was estimated from the measurement of four skinfold thicknesses using the equation of Siri (1956) for three different ages. Somatotype was determined according to Heath & Carter method (1967). All anthropometric parameters were taken according to the guidelines of Heyward & Stolarczyk (1996). Descriptive statistic was used for the analysis of the variables.

The main finding was that Greek male handball players, members of national team were endomesomorphic, whereas the somatotype of other European male handball players reported by other authors is balanced mesomorphy and ectomesomorphic (Stepnicka et al 1979,; Meszaros & Mohacsi 1982). Greek players had similar body height and body weight in comparison with the Danish male national handball players (186 cm and 89 kg respectively), but higher percent body fat (16.3% vs 14%) (Jensen & Johansen 1994).

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#### ABS-05

### **Assessment of the special preparation structure in endurance athletes as a base of individual training**

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*Keywords: endurance, training, individuality*

The special preparation control of a player is to make the optimum of a training process. The search for the optimum methods, regarding the individual competitor, has to take under account the following issues: biological traits of physical development and the adaptation responses to the training loads and other parts of a training structure as: optimum volume, intensity and training loads suitable for age, sex, sport and a competitor's qualifications.

Examinations have been run in order to elaborate the implementation of individualisation in a training process, based on the training of endurance run competitors in track-and-field as well as orienteering run competitors. The first step is connected with the structure of the special preparation of the competitors, regarding their age, sex, and specialisation in a particular sport or in track-and-field disciplines. Thus we can elaborate the control indexes and quantitative criteria for describing the development level of the tutor's motor skills which directly influence their contest effectiveness.

The control indexes were used and the quantitative criteria were statistically distributed on the scales which respond to statistic disposition of the results of the competitors. Comparing the obtained results, we can have the special preparation levels in all the competitors from one club, school etc. The control procedure is as follows: each competitor's control index is compared with the criterion given in table 1, and amount obtained from five indexes is the general measure of the special preparation level in a competitor. In this way it is possible to compare all the competitors from the same age, sex and specialisation then we can classify them according to the particular motor skill or special fitness. The contrast examples, in the table, have been given in order to show individual special preparation levels in each player.

There is possibility to make the training process much more effective for the A and B competitors. They should practise on the ground of the individually designed training programmes. The above given example can be considered as a standard at describing the main tendency of further development of the theory and methods of sport training regarding individualisation.

**ABS-06**

**Changes in the attitudes towards PE teacher career**

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*Keywords: professional orientation, attitude change, teacher's activities*

At the present moment, our system of public education tends to change because of the rapid changes in the scientific and technological development, and of the requirements of the accelerated and drastic changes in our society. The renewal of the notion of education is reflected by the appearance of different types of school systems, the variety of educational reforms, curricula including the requirements of a high quality development, the multitude of opportunities of education at different levels, the vigorous and rapid establishment of the autonomy of institutes of education.

The choice of a profession and career remains an issue to be clarified even in the course of modernisation of public and higher education. Its significance is emphasized by the fact that the time spent in work is considerable, and at the same time it is our career.

These changes increase our responsibility for making decisions upon issues, evaluating our past experiences, which ensure the future of experts capable of executing the increased and changed tasks. Highly qualified and well-trained experts are needed at the labour market, who are qualified (command of foreign languages, communicative and management skills and skills to use computers, etc.) for carrying out tasks according to the European standards. The teaching profession, pedagogy, is no exception. Moreover, due to the requirements related to our joining the EU, as a consequence of the changes, a strategy, a programme, is needed for educating and training a new type of teachers.

In the present study, we investigate:

-- what changes in the attitude of the applicants to the Institute of PE and Sport Science, towards their future career have taken place in the recent 15 years.

-- whether significant changes can be pointed out between the applicants in 1987 and 2002.

A Likert type of five-grade multiple choice questionnaire consisting of twenty statements was compiled. As a basis of comparison, the same method and mode of appreciation was used at the entrance procedure in 2002.

We hold the opinion that in spite of the changed circumstances, it is significant to know what attitude the applicants towards different areas of higher education have. On the one hand, this information can be used for both developing structures of education and training, and for choosing the substance corresponding to the new requirements and circumstances. On the other hand, they provide information about the increasing and decreasing trends in the incentives needed for choosing a career, which raise further issues concerning education and development of personality.

**ABS-07**

**Differences between winners and losers of individual games in terms of time spent in front, middle and back thirds of court at squash matches**

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*Keywords: squash*

Squash matches are divided in several games and each game is divided into an active and a passive period. The active period consists of several rallies, during which the player tries to score a point by playing the ball and forcing his opponent to move to a different part of the court. The player's movement (speed and distance covered) and positioning on the court depends, among other, on his way of playing. The aim of this research was to measure the time the players spend in any of the court thirds (front, middle and back) during a rally, and to indirectly establish whether the winners of individual games play more offensively than the losers.

Our hypothesis was tested on a sample of 24 games in 6 matches played by eight top-ranked Slovene, Austrian and Bavarian squash players. The player's movements throughout these games were recorded by a fixed SVHS video camera with a frequency of capturing input pictures of 25 Hz. The recordings were digitized using a video digitizer and processed by the SAGIT/SQUASH tracking system. The system allows tracking the player's positions on the predefined segments of the court. The data was analysed with one-way analysis of variance.

There were no statistically significant differences between the winners and the losers of individual games in terms of time spent in the described court segments.

This means that the winner's and the loser's tactical way of playing in individual games were very similar. Both, winners (56.3%) and losers (56.4%), stayed the longest in the middle third, and such a high percentage is due to the player's positioning on the basic position (T) in the middle of the court. Very low percentages of time spent in the front third indicate that all players played under control (cautiously) or defensively. Any further research should verify these results on other samples of players and check the position of the ball at the time it is hit and not only the player's position.

**ABS-08**

**Differences in morphology and motor abilities in 12 year old tennis players**

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*Keywords: motor abilities, tennis, morphology*

Differences in morphology and motor abilities in 12 year old tennis players

The development of the game of tennis and permanent growth of its level encourages undertaking the training already in early childhood. Players from almost every tennis federation take part in international competitions at 12 years of age already. At that time young athletes have already spent five to six years exercising in clubs. The purpose of this research was to analyse similarities and differences in morphological characteristics and motor abilities of young tennis players of different gender.

Study group was composed of 19 boys and 16 girls (age  $10.95 \pm 1.02$  and  $11.03 \pm 1.07$  years respectively). To assess the body composition 30 morphological parameters were measured. According to them body mass index (BMI), sum of seven skinfolds and somatotype were calculated. Motor abilities were examined by seventeen tests. To compare boys and girls analysis of variance was performed.

Height and weight for boys and girls were  $154.48 \pm 9.25$  (mean  $\pm$  standard deviation) and  $150.35 \pm 11.07$  centimeters as well as  $42.12 \pm 7.06$  and  $39.53 \pm 9.03$  kilograms respectively. Among 30 morphological parameters statistically significant differences exist only in knee breadth presenting boys ( $9.21 \pm 0.43$  cm) with bigger knee breadth than girls ( $8.70 \pm 0.48$  cm) ( $f = 8.69$ ;  $p < 0.01$ ). Comparing these two samples in set of seventeen motor abilities statistical significant differences were found only in flexibility presenting girls more flexible ( $6.34 \pm 5.9$  cm) than boys ( $-2.2 \pm 9.2$  cm) ( $f = 9.59$ ;  $p < 0.00$ ). In other motor abilities tests for speed, agility, strength and endurance no differences were found.

This examination presents young male and female tennis players as similar samples in morphological characteristics and motor abilities. This allows them to exercise together without different approach in training load.

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## ABS-09

### Effects of a 40-minute in-court fatigue protocol on ground reaction forces during basketball free throw in amateur players

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Keywords: *basketball, biomechanics*

Fatigue is an important factor which may have an effect on sports performance. Previous studies examined the effects of various fatigue protocols on sport techniques of other sports but none have examined basketball shots. The purpose of this study was to examine the changes in ground reaction forces (GRF) during a standing shot during a simulated basketball game protocol.

Eight basketball amateur girls (age  $20 \pm 1.04$  years; height:  $1.70 \pm 0.57$  m; body mass  $62 \pm 11.6$  kg) performed a simulated fatigue protocol. The protocol was divided into 4 periods, each lasting 10 minutes. The time interval between periods was the same in length as in a normal basketball game. The fatigue protocol consisted of typical basketball movements such as jogging, running, changing directions, cutting and jump shots. The whole task was performed at a target heart rate of  $90 \pm 5\%$  of maximum. A free throw from a distance of 5 meters away and laterally from the basket was performed prior to, at the end of the 1st, 2nd, 3rd and 4th periods. GRF data were recorded using a Kistler Force Plate, which was mounted on the basketball court, without being noticed by the players. A one-way analysis of variance was used to examine the changes in 1st and 2nd maxima of the vertical, mediolateral and anteroposterior GRF during the fatigue protocol.

The vertical GRF ranged from  $1126.48 \pm 560.79$  N to  $1457.83 \pm 472.91$  N. The anteroposterior GRF values ranged from  $-52.18 \pm 20.87$  N to  $134.41 \pm 67.15$  N whereas mediolateral forces ranged from  $-43.02 \pm 30.17$  N

to  $80.54 \pm 46.72$  N. The ANOVA results indicated insignificant effects of fatigue in all variables ( $p > 0.05$ ).

The above results indicated that there were no significant differences in the GRF performing the standing shot during and after a 40 –min simulated basketball protocol. Since the players worked at levels above 90% of the maximum heart rate it could be suggested that any alterations in the technique of the basketball standing shot due to fatigue are not reflected on maximum ground reaction force data.

## ABS-10

### Effects of resistance training on glycemic control and systolic blood pressure in type 2 diabetes mellitus

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Keywords: *diabetes, strength training, aerobic endurance*

Aerobic endurance training has been advocated in the treatment of type 2 diabetes and it has been shown to have a beneficial effect on metabolic control and blood pressure. Our aim was to test the effects of a 3 months resistance training on glycaemic control and blood pressure in these patients.

Seventeen diabetics patients (10 male and 7 female) with a duration of disease rather one year, without hypoglycaemic medication and without major cardiovascular disease, with a mean age of 48,7 years were enrolled in the study. Nine subjects participated in a 3 months resistance training program. Another eight subjects participated in a 3 months aerobic endurance exercise training program and served as a control group. Both groups were under the supervision of a physical education instructor. At baseline and after 3 months were measured fasting blood glucose (FBG), Hb A1c value and systolic blood pressure (SBP).

After 3 months strength training mean levels of FBG were reduced from  $207,12 \pm 21,32$  mg/dl to  $135,62 \pm 9,54$  mg/dl,  $p = 0,003$ , Hb A1c value declined from  $8,57 \pm 0,32$  to  $7,17 \pm 0,18$  mg/dl and SBP were reduced from  $142 \pm 5$  to  $121 \pm 4$  mm Hg. The endurance exercise group showed improvements in lowering SBP from  $139 \pm 5$  to  $118 \pm 6$  mm Hg, but had a minimal effect on glycaemic control.

In this study strength training lead to decreased FBG, Hb A1c value and SBG in patients with type 2 diabetes. Strength training was superior to aerobic endurance exercise on glycaemic control and should play an important role in the treatment of type 2 diabetes.

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## ABS-11

### Electromyographic activity of lower extremity muscles in soccer players during drop jumps on a sledge ergometer

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Keywords: *EMG, soccer, testing*

Many soccer movements are characterized by explosive power activities, which involve rapid changes of eccentric and concentric muscle actions. The purpose of this study



was to examine the EMG activation patterns of selective lower extremity musculature muscle in trained soccer players during drop jumping from various heights and added weights by using of a special sledge ergometer.

Twenty amateur soccer players participated in the study, and were assigned to two groups according to the rank that their team had in the local division. Group I (n=10) consisted of soccer players from a higher local division, and Group II (n=10) consisted of soccer players from a lower local division. They performed maximum drop jumps on a special sledge ergometer from 20, 40, 60, 80, 100 and 120cm and the added weight was 1/3, 1/2 and 1/1 of the participants' body weight. EMG activity of the rectus femoris, (short head of) biceps femoris, and gastrocnemius muscles was recorded using bipolar surface electrodes. Ground reaction forces and sagittal video data were simultaneously recorded using a Kistler platform and Panasonic cameras, respectively. EMG and force data were recorded at 500 Hz, whereas the video data was collected at 60 Hz. An Ariel Performance Analysis System (APAS) was used to process all collected data. The test was divided into two main phases: eccentric stretching and concentric shortening phases. For each phase, the mean force and the maximum EMG were analyzed. One-way ANOVA was used for statistical analysis. The results showed that, the soccer players from the higher division had scores that were statistically different from the scores, which obtained by the soccer players from the lower division, in EMG variables measured in the study. This could be a result of different training methods of soccer players from the higher division. These results may have implications in designing training programs.

#### **ABS-12**

### **Health status and physical activity monitoring in Slovenia**

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*Keywords: strategy for health, sport activity*

Physical activity is extremely important to preserve and to strengthen physical, mental, spiritual as well as social health. It is also important to improve already damaged health. Today people take much less physical exercise than it was customary in the past. Physical labour occurs rarely. The technological progress from electrification to automatization has led to a new era and a more comfortable life, but at the same time it is the main reason for less physical exercise. A passive lifestyle is related to different health, social and economical problems. The level of physical activity in Slovenia is low. Problems, which result from that (the frequency of coronary diseases and the risk factors, economical expenses of the medical treatment and the absenteeism from work, a large share of the elderly, dependent population), are big enough that national intervention is required. The actual state must be estimated before a design of quality plans for the promotion of the meaning of the motor/sports activity for health as well as programmes of motor/sports activities for people to join.

The analysis of the actual state, based on a systematic examination of a representative sample of objective indices will allow us to determine the medical and motor status of children, adolescent and adult inhabitants of Slovenia, thus to identify the key arguments for strategic changes in the motor/sports activity for health. We expect

to contribute to the development of the quality of life of the Slovenians by the realization of objectives that follow one another hierarchically from the analysis of the present situation to the evaluation of the possibilities for a quality promotion and realization of motor/sports activity programmes.

*Beunen G et al (1992). Medicine and science in sports and exercise, 24: 576-585*

*Malina R, Bouchard C (1991). Growth, Maturation and Physical activity. Human Kinetics*

#### **ABS-13**

### **Must sport coaching become a professional guild?**

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*Keywords: athletics, coaching, pedagogics*

A major concern in contemporary competitive sports is coach development, educating and training coaches for youth sports and for high performance or elite athletics. Many programs exist at the local, national and international levels, but the nature of today's sport leads to the greater question of what is the best approach to coach development.

A question that arises is whether the profession of coaching should become more like an exclusive guild, with those who do not meet strict education and experiential requirements barred from participation and recognition. Guilds arose in medieval Europe as a way for artisans and professions to ensure a certain standard or quality in their products or services. They also served as a gate that limited competition from the outside. Several difficulties make the design of a coach development system more difficult. First, most coaches are local volunteers. They usually receive little, if any, funding or support for their efforts on behalf of their athletes. Setting stringent professional requirements for the status of coach could render it impossible for most youth sports to survive. Second, most of the suggested models for coach certification programs are big institution models, serving concentrated populations, which are relatively easy to develop. The reality is that most of the world is small scale, with smaller, more scattered populations, which require mixed (rather than specialized) roles. Also, there are sometimes issues of snobbery in programs aimed at professional development. This is the idea that only we [the certified professionals] are the real coaches. This tendency to view coaches with less training as less worthy is a disservice to sport, as it views sport below the elite level as inferior not just in quality, but in value to the public. Thus we need to provide broadly-based coach education programs that recognize that different nations, cultures and populations have differing needs. Those needs may require special approaches to meet their ultimate goal of providing quality coaching services to a wide range of ages, skill levels and talent potentials.

ABS-14

**Oxygenation of forearm muscle during intermittent exercise before and after one month of training**

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*Keywords: intermittent exercise, oxygenation, infrared spectroscopy*

The aim of the study was to ascertain the effect of one month training of isometric contractions on duration and oxygenation status of forearm muscle during intermittent exercise.

Eight untrained males (22±2 years, 67±6 kg, 175±12 cm) performed a trial of hanging on two ice-axes until voluntary exhaustion. Hanging consisted of 30 s contraction followed by 30 s relaxation intervals. Tests were followed by a month of training that consisted of squeezing of rubber rings of about 40-45% MVC 4-10 times to fatigue, 5 times per week. the oxygenation of forearm muscles was measured by using laser Near Infrared Spectroscopy OXYMETER (ISS, USA). Analysis of time courses of oxygenated haemoglobin-myoglobin (OXYHb) and total haemoglobin-myoglobin (TOThb) concentrations were performed thereafter. Relative changes were further used for comparison of individual and group data before and after training. A paired t-test for small groups was selected and a level of 5% significance was used.

One month of training did not increase the average time of hanging (892±480 s pre, 1012±615 s post training). When oxygenated status was compared, then OXYHb during contraction intervals did not changed by training. Differently OXYHb during relaxation intervals was lower after the training (P<0,05). TOThb did not change significantly due to training. However individual values showed tendency for more positive TOThb during relaxation intervals and more negative during contraction intervals. This phenomenon can be explained as increased muscle oxygen consumption during relaxation intervals as training effect.

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Usaj A (2002). *Cellular & molecular biology letters* 7 (2) 375 - 377

ABS-15

**Physical activity diary method and perceived exertion in secondary school students**

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*Keywords: diary method, perceived exertion, secondary students*

The purpose of this study was to characterize the level of physical activity, determined by a physiologic approach (heart rate) and from a psychophysiologic approach (diary method based on Borg's scale of rating of perceived exertion) recording during all day. The data collected served also to establish a relationship between heart rate and rating of perceived exertion, which permit determine the accuracy level of the subjects, in relation to level of perceived effort.

Twenty eight adolescents (15 girls and 13 boys), students of secondary school, volunteered for the study. All subjects were studied during two separate days of a week (2 x 24 hours) in order to measure and record heart rate values. Simultaneously, the students were asked to fill in periods of thirty minutes a diary of physical activity. They were instructed to use Borg's RPE scale (6-20) and record the values in the diary. Linear regressions were performed between heart rate and registered diary values based on Borg's scale, considering heart rate as independent variable.

Statistical analysis from correlation coefficient of Pearson revealed high correlation between heart rate and diary method values based on Borg's scale for both girls and boys. When subjects were separated in more and less active statistical significant correlation (p<0.05) can be observed in more active boys (r=0.568; p=0.000), less active boys (r=0.471; p=0.000) and less active girls (r=0.478; p=0.000). Only more active girls did not show statistical significant correlation (r=0.044; p=0.518).

The principal finding of this study was that diary method based on Borg's scale of rating of perceived exertion is a good way to measure habitual physical activity in both secondary school students girls and boys. The current design study represents an attempt to join different methods to measure and characterize habitual physical activity: diary method, rating of perceived exertion and heart rate. In spite of using activity categories to estimate energy expenditure the subjects can use Borg's RPE Scale values as resulted from this study. High correlation between heart rate and Borg's RPE Scale values means that both girls and boys has a good perception of physical exertion.

ABS-16

**Qualitative sports using quantitative assessments: diving, a case study**

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*Keywords: judging, quantitative analysis, diving*

The assessment of qualitative sports over the past few decades has proved to be problematic, which has recently been highlighted by the controversies at the Winter Olympics. The investigation into the judging of qualitative sports was chosen, as there is very little research on the subject, thus the purpose of this study was to explore the consistency of judging in qualitative sports using quantitative methods. The sport of diving was used as a case study.

Ten competitions were analysed live, using a devised hand notation system to record the judges' scores. The same ten competitions were also analysed by two independent judges, post event from video recordings. The two judges awarded scores using the current judging format as well as an alternative method called component analysis.

Analysis of the competitions using the live event judges was undertaken using the US Management Meet Programme (1995). The analyses included data for each placed individual and a summary table in which the rank of the diver, total ranks deviations and the number of times the judge was above or below the panel was presented. Statistical analysis was non-parametric and the tests that were undertaken were the Rank Order Correlation Coefficient test and The Friedman's Two-Way ANOVA.

The originality of the study has meant that the results are unique in their findings. Results show, that clear

distinctions exist between the competition judges and the post-independent event judges, although the judges at the event were in agreement. The conclusions from the results illustrated that the post-independent judges awarded a far wider range of marks for dives than the competition judges and that component analysis was potentially a beneficial learning tool for inexperienced judges, enabling them to gain the necessary knowledge and apply it to competition settings.

#### **ABS-17**

### **Relationship of three fitness variables with skinfold thickness among 9 year old children in the capital of Iceland**

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*Keywords: physical fitness, body composition, physical activity*

The prevalence of lifestyle-related health problems and inactivity has increased in the past few years. The aim of this study was to investigate body composition, physical fitness, physical activity, and lifestyle among nine year old children in Iceland.

All nine year old children from four randomly selected elementary schools in Reykjavik (307 children) served as subjects for the study. Informed consent was received from the parents of 237 children (77%). Body composition was assessed through measurement of skinfold thickness at 4 locations and physical fitness was assessed with the Multi-stage Fitness Test. Physical activity by Actigraph accelerometers (MTI, AM7164) was assessed for 57 randomly selected children. Lifestyle was surveyed through sociological questionnaires. In one item the parents estimated their children's fitness on a five point scale. Measurements were conducted in September and October 2002.

Significant difference was found between the gender with regards to skinfold thickness and physical activity but not for physical fitness or parents' estimate of it. Physical fitness showed the highest correlation with skinfold thickness ( $r=-0,486$ ;  $n=205$ ;  $p<0,001$ ). Physical activity ( $r=0,422$ ;  $n=46$ ;  $p=0,004$ ) and parents estimate of their children fitness ( $-0,383$  ( $n=209$ ;  $p<0,001$ )) followed. Using multiple regressions all three fitness variables contributed significantly to explain skinfold thickness but the gender variable did not.

Although the three fitness parameters used in this study are related they all contribute to some extent independently to predict skinfold thickness with physical fitness being the strongest single predictor. The study shows that low physical activity together with a low physical fitness is a strong predictor of obesity for both gender in children. The observed difference between genders in skinfold thickness can be explained by difference in physical activity.

#### **ABS-18**

### **Rewritten the body and the sports practices-new challenges**

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*Keywords: physical education, body values*

The body must be a concern of physical education teachers because it's in their discipline that it is viewed as an object of pedagogical treatment, and where is revealed the way that the educational system understands it. But, which is the role of the body in physical education? What values does it express? What, in fact, do students and teachers valorise when we ask them: "what is really important when we talk about the body values in physical education?"

The main goal of this study was to analyse the body from an axiological perspective, by looking through the lenses of discourses (teachers and students) in physical education. Data for this study were collected from 6 schools in Grand Porto, Portugal. One 9th grade class per school was selected and the respective physical education teacher and students were interviewed. In order to inspect the material we have applied the content analyses technique (to the 12 interviews) introducing a priori defined categories.

The analysis of the material reveals some discrepancy between teachers and students discourses. In general the biological/mechanical body category and the ethical category are paramount in teachers discourses. There are few references concerning the expressive body at all discourses (teachers and students). The elements of pleasure, so highly valued in the literature, are also values in the discourses of teachers and students, both sustaining in their particular views the importance of such elements. Some teachers recognised some importance in their discourses to the experiential body category, but students say that those aspects are not valorised at physical education classes. The body as a social construction, so important in the current discourse outside school, does not seem to deserve any relevance within school settings.

We must rethink the contemporary physical education in sense to becoming corporally richer in all dimensions, in a way that boys and girls can find more gratifying moments and humanly richer ones, through new practices and new ways to experience their bodies.

*Fernández-Balboa J (1997). Quest 49: 161-181*

*Kirk D (1997). Quest 49: 182-186*

*Queirós P (2002). O corpo na Educação Física, Leitura axiológica à luz de práticas e discursos, Doctoral Dissertation, FCDEF-UP.*

#### **ABS-19**

### **Romanian olympic gold medallists' age, gender and background general reviewing (1952 - 2000)**

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*Keywords: age difference, gender difference, Olympics*

Continual growth in the number of participants, as well as of the Olympic female events makes it more difficult to get on the Olympic honor stand and requires an ever better knowledge of the determining factors in acquiring sports

excellence. Our research will be focused on several aspects related to age, sex and background of the Romanian Olympic champions, starting from 1952, when the first Olympic gold medal was won, and until 2000 when the general standing on medals placed at the 11th position.

The methods employed are related to the statistical analysis of the existing data on the Romanian Olympic champions in the summer OG competitions. For the background, we considered the urban or rural location of the place of birth, in any of the four historical regions of our country.

Following the general tradition in the modern OG, the Romanian male participation and the diversity of their sports events was greater than the one of their female counterparts. The sports we won gold medals in were: combat sports, athletics, swimming, nautical sports, shooting, cycling, gymnastics, weightlifting, return games, sports games, riding and combined sports. The largest number of medals was conquered in nautical sports, i. e. rowing and kayak-canoeing. In Ro, excellence sports are the nautical sports (kayak-canoe with men, rowing with women) and sports gymnastics (girls). The number of Olympic gold medallists is 112, of which 66% are females and the other 34% are males. The average age of the male gold medallists is 25.6±3.6 ys, and of the female medallists is 24.7±5.8 ys. Romanian champions are included in the age intervals 15 – 36 ys old and this fact is determined by the competition rules and the athletes' performance longevity. Olympic participation is longer with the women. The background is 47.3% urban for females and 34.2% for males. Most of the gold medallists in the nautical sports originate from the Danube Delta, an area where rowing is the natives' everyday occupation.

In order to eliminate the influence of the factors pertaining of inevitable unpredictable elements in the sports competitions, the analysis of the Romanian participation in the OG needs to be extended with a study on the athletes classified on the first six places in the standings.

## ABS-20

### Social and educational aspects of weight control in high school girls

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*Keywords: physical education, weight control, education*

Social and educational aspects of weight control for overweight girls are important for their psychosocial health. Expected is that for successful resolution of problems relevant to educational aspects of weight control, greater success could be achieved by resolving the socialization problems of the overweight girls. The objective of the research was to determine the social and educational aspects of weight control among high school girls.

The index of body mass and a questionnaire were used for this research. The weight of a respondent was assessed in accordance with the body mass index. Participants in this study were divided into two groups as determined by the body mass index: Normal weight (BMI < 23) and Overweight (BMI > 24). Division into weight groups and results of the division were done anonymously; in other words, the participants were not provided with this information. Social and educational aspects of weight control were established by means of a questionnaire. The administered questionnaire was the same for each respondent, irrespective of their weight. Two blocks of

questions comprised the questionnaire, as follows: the first was related to educational aspects, and the second - to social aspects of weight control. Answers to the first block of questions determined literacy in the area of weight control; that is, information about weight control, and the skills to incorporate such in daily life. The second block of questions was of a subjective type that evaluated social integration with contemporaries of the same age. The questionnaire was prepared at the Social Research Laboratory of the Lithuanian Academy of Physical Education, and approbated by the retest method. Participants in this research were high school girls of 15 - 16 years of age. There were a total of 81 respondents. The research took place in the spring of 2002.

Measures of the social aspects, relevant to weight control in 15-16 year old girls, revealed possible problems, related to being overweight: negative evaluation of the self, and a subjectively understood view of them by their contemporaries; and a poor sense of spirit and presence of personal complexes. Measures of the educational aspects revealed unsatisfactory literacy in the area of weight control amongst 15-16 year old girls.

## ABS-21

### Test-retest reliability of isometric lower limb strength measurements and single legged hop test in uninjured subjects and in patients after ACL reconstruction

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*Keywords: knee*

The purpose of this study was to investigate reliability of maximal isometric strength measurements and single legged hop tests (for distance) in patients after anterior cruciate reconstruction (group A; n=15) and in uninjured subjects (group B; n=20).

Maximal isometric knee extension and flexion strengths (N) were measured in 60° and 30° of knee flexion with Good Strength<sup>®</sup> force dynamometer (Metitur Ltd, Jyväskylä, Finland). After isometric strength measurements single legged hop (both limbs) was tested. The best result of three consecutive trials was used. All subjects were retested three days later. The results were evaluated with intraclass correlation coefficient (ICC), coefficient of variation (CV%) and with paired T-test.

All ICCs between test and retest were statistically significant (p<0.001). ICCs of knee extension strength measurements varied from 0.90 to 0.97 and CVs from 3.7 to 6.3 % and ICCs of knee flexion strength measurement varied from 0.94 to 0.97 and CVs from 4.5 to 7.0 % in group A. ICCs of knee extension strength measurement varied from 0.94 to 0.97 and CVs from 3.0 to 5.6 % and the ICCs of knee flexion strength measurements varied from 0.88 to 0.91 and CVs from 4.8 to 6.9 % in group B. The single legged hop tests using uninjured limb (both groups) seemed to be more reliable (ICCs 0.98, CVs 1.5 - 2.1 %) than tests on the reconstructed limb (ICC 0.84, CV 5.5 %). There was a tendency to improve performance in almost all tests during the retest. The improvement was significant (p<0.05, T-test) in extension strength measurement (in 30°) of the reconstructed limb and in flexion strength measurement (in 30°) of the unoperated limb in group A.

These results suggest that maximal isometric strength of the extensor and flexor muscles of the knee joint can be

measured reliably with Good Strength<sup>®</sup> force dynamometer in young uninjured subjects and in patients after ACL reconstruction. To enhance reliability more than one baseline measurement should be used. The reliability of single legged hop tests for distance seemed to be better in both ACL group and in control group than found in previous studies. Maximal isometric strength measurements and single legged hop tests are easy to perform, reliable and provide useful information during rehabilitation after ACL reconstruction.

Keays SL et al (2001). *The Knee* 8: 229-234

Paterno M, Greenberger H (1996). *Isokin&Exer Scie* 6:1-6

## **ABS-22**

### **The effect of a lower limb muscular strength program on body equilibrium**

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**Keywords:** *muscle strength, optoelectronic analysis, body equilibrium*

In sport performance, body posture is continuously challenged. In this study, the 3-D movements of a subject positioned on a tilting platform were quantified (Sforza et al, 2003). The effects of two different training programs on maintaining equilibrium were investigated.

Twenty one young healthy men (age 22±3 yr) were asked to stand in bare feet on a tilting platform, and instructed on keeping it as horizontal as possible during a 30-s test. The feet were to be maintained on the platform at a 24 cm distance. The 3-D movements of the subject were filmed by an optoelectronic system, and analyzed by the original software in the last 20 s of each test. The displacements of 13 retro-reflective markers positioned on standardized body-landmarks of each subject were recorded. A body axis directed to the center of gravity of the platform was defined as the line connecting the midpoints between the two acromia and the two hips. Its displacements relative to the platform were quantified by calculating the area of the 90% standard ellipse of the relevant cosines. The task was repeated three times. The subjects were randomly divided in two experimental groups. They respectively participated in: a) a 13-week program of lower limb muscular strength; b) a 4-week program of training on the platform. Two control groups were also defined. Data were collected in two sessions, before and after the training programs. For each subject and session, mean values of the area of standard ellipse and the angular velocity of the body axis were computed over the three trials, and the differences between the two sessions calculated ( $D\% = |I-II| / I\%$ ). Data were compared by paired Student's t test. Significance was set at 5%.

Experimental groups registered a significant D% of the area of the 90% standard ellipse and of the angular velocity ( $p < 0.01$ ) between sessions. Control groups registered no significant differences.

The ability on maintaining equilibrium could be trained (Sforza et al, 2003). The experimental groups showed a significant reduction of the ellipse area of oscillation and of the angular velocity between sessions. The smaller the area of oscillation and the lower the angular velocity, the more stable the subject. Both programs could improve equilibrium. Different necessities (period of training, available instruments) could suggest the training program.

Sforza C et al (2003). *Percept. Mot. Skills* 96: 127-136

## **ABS-23**

### **The reason of blood lactate tests in young middle distance runners**

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**Keywords:** *young athletes, training, blood lactate*

In this study, blood lactate trend in young middle distance runners was examined through an increasing aerobic exercise. The purpose was to check if the relation between the athletes' running speed and correspondent blood lactate values could give right information about the tested athletes' fitness in different moments of the season.

21 middle distance high performing runners, male, mean age 16 (S.D. ± 2). Blood lactate was measured with 'Lactate Pro-blood Lactate Test Meter' instrument. All athletes were tested 3 times, each separated by two months: on the eve of competitive period, at the end of competitive period, at the beginning of following season. The test protocol consisted of 4 increasing speed runs, with the first run at 16.00 Km/h, and the last one at 18.95 Km/h. Rest was fixed in 1 minute, required time to blood sample. Found data were examined considering official athlete's performances, to control statistical correlation.

Running speed at the anaerobic threshold decreased not significantly by 1.4% from 1st to 2nd, by 3.5% from 2nd to 3rd, by 4.9% from 1st to 3rd.

Blood lactate measuring, at different running intensities within the interval of one year, highlighted no significant variation in mean values of speed at the anaerobic threshold. In spite of the fact that athlete's trainers and training methodologies were different, it was proved that all tested athletes, although adolescents, haven't had any rest period during the considered year. This observation explains why a large part of the young athletes had progressively decreased data and performances from 1st test and was afflicted by overuse injuries.

## **ABS-24**

### **A comparative analysis focusing on problem solving skills of first year students majoring in either physical education or other subjects, in the framework of a PE teacher role-play**

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**Keywords:** *physical education, gender difference, educational styles*

The significance of teacher training, for both PE and non-PE teachers' education, is waning so that it has almost become commonplace in the last few years.

In almost all areas and levels of educational work, a strong emphasis has been put on both the development of the educational system as well as the necessity for improving teachers' and students' personal and behavioural developments.

In our basic research we have decided to test the physical education undergraduates at the department of physical education. One of the basic elements of this research is to compare the PE students' educational style with those undergraduates who have other majors.

As a result of our research programme, it must be determined whether there is a major difference between the two groups at the beginning of their studies.

If there is, we might believe that future PE teachers' are a bit more qualified in this area, but we have to decide whether this qualification serves our profession's requirements or not.

The aim of our programme is to work out a method, which helps to increase the efficiency of PE teachers' activity and which can be used to examine the future teachers' work, so their technique could be tested in the stand-point of a particular class or group.

In our opinion the analysis of the solving ability in certain conflict situations of PE lessons corresponds best to this examination.

Considering previous experiences which examined both groups (PE and non-PE students), we realised that we can demonstrate their educational style in a 5 - dimensional co-ordinating system in which we name the 5 axis such as: Aggressive, Restrictive, Co-operative, Inertial, Indifferent, and the variations thereof

Our work theory can be defined as follows:

It is presumable that if we outline typical conflict situations that are common in elementary school and ask the examined individuals to imagine these situations in a role-play, then the differences between PE and non-PE students will arise. At that point, the following questions can be answered:

- a) Can we reveal a certain picture to PE and non-PE students, through which they can realise the positive and negative sides of their own styles?
- b) Are there any personal features for example: organising ability, leadership, or co-operating ability, which are indispensable for being a PE teacher, and if there are do they turn up in a dominant way among PE students?
- c) Can we demonstrate various educational styles, which are used by the students and dominant in both tested groups?

## **ABS-25**

### **A teaching unit for fairness education**

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*Keywords: physical education, fairness, teaching unit*

Research points to the importance of Physical Education incorporating issues relating to fairness and fair play. However, to date few detailed descriptions of teaching units suited to improve pupils' concepts of fairness exist. This paper describes a teaching unit in which pupils were deliberately confronted with situations necessitating reflection on the issue of fairness (fairness education class, FEC), and compares this in terms of efficacy with a teaching unit in which the topic fairness was not explicitly discussed (physical education class, PEC).

A six-week handball-unit stood at the centre of teaching in both classes; however, different approaches were used. In FEC, the contents of the teaching unit centred on developing rules for fair conduct between players. The main question was how each and every player should act both off and on the field so that everyone could enjoy the game. To do so, short cognitive phases in which the pupils were asked to reflect possible rule changes or codes of conduct were integrated into lessons. Cognitive phases were complemented by handball-specific games with different demands to fairness. In PEC the same games were played throughout the teaching unit, however, no

explicit mention of aspects relating to fairness was made. The same amount of time was allocated for cognitive phases; however, instead of fairness issues, technical and tactical issues concerning handball were discussed.

The atmosphere in FEC during games became noticeably more relaxed in the course of the teaching unit. Interventions by the teacher became less frequent, one reason being that the number of fouls decreased; the other reason was that pupils were able to resolve a lot of disputes themselves. Generally speaking, the pupils in FEC appeared committed to the overall aims of the teaching unit.

The general atmosphere in FEC at the end of the unit in points towards greatly improved overall fairness behaviour, whereas hardly any change was noticeable in PEC. A possible explanation for this may be that pupils identify themselves more with rules and code of conduct when they create these themselves, as opposed to having them imposed by a teacher. The results lend support to the notion that PE lessons can benefit from explicit fairness education.

## **ABS-26**

### **Anthropometric measurements estimating body fat content in adolescent ballet students**

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*Keywords: body fat, anthropometry, ballet*

Anthropometric characteristics are important in sporting as well as in ballet dancing. Body composition can be changed by training, but some anthropometric characteristics are determined genetically. The ideal ballet dancer is not very tall (female 160-168 cm, male 175-185 cm) and thin with low body fat content. Their joints are flexible, their muscles stretch easily and also fast and strong. Since the low body fat content and the psychological stress (fear from obesity) increase incidence of delayed onset of menstruation, irregular menstrual cycle (oligomenorrhea) or complete cessation of menses (amenorrhea), quantitative measurements on ballet dancers are important.

Anthropometric data were obtained from 20 female ballet students (age 17,4 yrs), 19 female physical education students (age 20,1 yrs) served as control group. The ballet students dance 13 hours a week, the control group trains 12 hours a week. 36 measures were made on the typical anatomic parts of the body in every female. We calculated with 4 different equations (Dumin and Womersley, Wilmore and Behnke, etc) using anthropometric data to estimate body composition.

Significant differences were found between the two groups in most anthropometric data, 27 from 36. The ballet dancers data were decreased in every anthropometric parameters. The body fat % according to the equations were 20.8, 20.2, 23.3, 18.3 in ballet dancers while 22.6, 23.0, 25.4, 19.8 in the control group. Significant differences were found in different methods estimating body fat content. In the ballet students group 18.3-23.3 % while in the control group 19.8-25.4 % body fat content were estimated. Since no method estimates body composition easily and perfectly, there are differences in body fat % in literature.

ABS-27

**Cardiovascular risk factors and leisure activities of parents**

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*Keywords: leisure-time activity, family, cardiovascular prevention*

Primary prevention is an increasing necessity in avoiding cardiovascular diseases. Therefore, the influence of physical activity is indisputable. This study analyses the cardiovascular risk factors of the parents regarding their leisure time activities within the CHILT-project.

1107 parents (49.5% fathers, 50.5% mothers) were asked for their anthropometric data, cardiovascular diseases and physical activities. The activities were summed up as complete physical activity and put into the following groups: no physical activity, only irregular physical activity, regular physical, only organised and both organised and regular activity.

On average, the parents were  $36.63 \pm 5.35$  years old, height  $172.47 \pm 9.39$  cm, weight  $73.12 \pm 14.10$  kg, BMI  $24.48 \pm 3.78$  kg/m<sup>2</sup>. Risk factors: 40.8% overweight/obesity, 5.6% hypertension, 5.0% hypercholesterinaemia, 1.5% Diabetes mellitus. There was no case of metabolic syndrome, but in 0.6% (n=7) overweight, hypertension and hyperlipoproteinaemia. In 40.8% a positive familial history was known, 41.4% were smokers. Leisure time activities: Inactivity was reported in 34.5%. 6.9% were irregularly active, regularly and irregularly active were 38.7%, in organised sports were 7.9%, regularly active and in organised sports were 12.0%. BMI was lowest in the most active groups (p=0.042). There was no correlation between physical activity and parents with hypertension, hypercholesterinaemia and diabetes. Within the most active groups less smokers were found (p=0.042).

The leading cardiovascular risk factors besides a positive familial history were overweight/obesity, smoking and inactivity, taking into account that the majority of people concerned do not see their doctor regular yet. These findings underline the importance of cardiovascular prevention and an active lifestyle of the parents, also in their role as examples for their children.

ABS-28

**Cortical neural stimuli and elite performance across diverse sporting disciplines**

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*Keywords: performance, neural stimuli, Mozart effect*

Although athletes frequently report using music to motivate or concentrate during training or prior to an event, limited research has investigated its effects on performance. Recent scientific findings suggest that listening to the first movement of Mozart's Sonata for Two Pianos (K. 448) causes a short-lived, but significant improvement in spatial-temporal reasoning, known as the "Mozart effect". The purpose of this study was to investigate the hypothesis that a specific neural stimulus can enhance specific performance indices of elite athletes across diverse sport disciplines.

A repeated-measures, randomized block design required 26 elite male soccer players (12-16 yrs.) and 24 elite male cricket players (14-17 yrs.) to perform both spatial-temporal organization speed and skill drills. Speed was assessed as time needed to perform a required task whereas skill was assessed as the absolute score achieved in the skill task. Drills were performed twice on 2 separate days, which included a 10-minute relaxation period prior to testing. Mozart's Sonata was randomly implemented on headphones during one of the 2 sessions. During the remaining session, subjects were exposed to a silent recording.

Analysis of variance indicated that performance in the skill test was significantly enhanced in both soccer (p<0.001) (stimuli =  $41.76 \pm 17.15$ ; non-stimuli =  $33.38 \pm 15.07$ ) and cricket (p<0.05) (stimuli= $10.10 \pm 2.54$ ; non-stimuli =  $9.07 \pm 2.54$ ) following the music stimuli session. Conversely, the stimuli contributed no significant (p>0.05) enhancement in speed for either soccer (stimuli= $4.90 \pm 0.48$ ; non-stimuli= $5.01 \pm 0.24$ ) or cricket (stimuli =  $5.77 \pm 0.46$ ; non-stimuli =  $6.02 \pm 0.58$ ).

Results suggest that spatial-temporal stimuli can significantly enhance skill performance of elite athletes in soccer and cricket. Further research is required to evaluate the "Mozart effect" across other sport disciplines.

ABS-29

**Cycloergometric methods in assessment of anaerobic capacity in young soccer players**

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*Keywords: anaerobic capacity, soccer, cycloergometric methods*

The Wingate test provides a complete picture of the level of athlete's anaerobic capacity. Short time (30 seconds) considerably limits soccer player's abilities in revealing his full potential of anaerobic capacity (Gabrys T. 2000). The objective of this study was to compare three different tests. The study group: 28 soccer players, aged 17-18. Exercise: -the 10-sec test: max. intensity (load - 10% of body weight), measure max. anaerobic power; -the 30-sec test submax. intensity (load - 7.5% b.w.), -the 3x60-s test: submax. intensity, load 7.5% of b. w. Test 2 and 3 measure power and anaerobic glycolytic capacity. In 4th, 7th, 9th min after test the lactate concentration (LA) in blood was assessed.

The max. anaerobic power (Pmax) was recorded in 10-s test ( $12.2 \pm 0.8$  W/kg). In 30-s and in 60-s tests values of that parameter were statistically of lower value (p=.001), though the difference between values of those two tests was not statistically significant (respectively  $10.7 \pm 0.7$ ;  $10.6 \pm 0.8$ ). Shorter time (p=0.05) of reaching maximum power (tuz) in 10-s test ( $3.91 \pm 0.59$ s) was noted, when compared with values recorded in tests of longer duration ( $4.38 \pm 0.59$ ;  $4.59 \pm 1.04$ ). There was no statistical relevancy between values of Pmax, tuz and tut recorded in 30-s and 60-s tests. However, there was significant difference (p=0.01) between  $\Delta$ LA (respectively  $10.6 \pm 2.5$  and  $14.8 \pm 2.4$  mmol/l). Statistically correlation was noted between values of parameters recorded in 30-s and 60-s tests: Pmax (r=.656, p=.01), WTOT (r=0.526, p=0.05), tuz (r=.588, p=.05). There was no statistical relevancy between  $\Delta$ LA in both tests.

The 10-s test assessment of maximum anaerobic alactic power. The 30-s test does not allow for accurate and complete assessment of athlete's anaerobic capacity. This

test seems to be useful only in assessment of glycolytic anaerobic power. The 60-s test allows for accurate assessment of soccer player's anaerobic capacity, though in the sphere of anaerobic glycolytic power this test provides incorrect information, as does the Wingate test.

Gabrys T. 2000. *Sportmen's anaerobic capacity*, AWF, Katowice

## ABS-30

### Degenerative disease and quality of life in successfully high competitive sportsmen

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**Keywords:** *degenerative disease, quality of life*

We observed a group of extremely successful sportsmen, of the most won medals on World Championship or Olympic Games. All of them were the members of national selection for a long period.

We analyzed:

1. The Degree of degenerative disease with RTG evaluation
2. The Medical recordings during their carrier
3. The Quality of living according to an appropriate rating scale

RTG verified degenerative disease of third degree in all of them (examined), in at least one articulation.

Beside their successful carrier, they have a high level of activity and a very well quality of life after finishing professional or even sport carrier.

## ABS-31

### Differences in body fat of British children from various ethnic groups

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**Keywords:** *physical activity, body fat, ethnicity*

In the western world, fatness is an increasing problem and the problem of adult obesity is reflected by an increase in childhood and adolescent overweight and obesity (Armstrong and Welsman, 1997). The aim of this study was to assess the percent body fat of young people in the City of Birmingham and examine any variation in body fat according to gender and ethnicity.

Seven Hundred and Eighty Six (339 boys and 447 girls) children, aged 11-14, mean age  $\pm$  S.D. =  $12.8 \pm 0.97$  years participated in this study. Children's height and weight were recorded using a Seca stadiometre and weighing scales (Seca Instruments Ltd, Germany). Body fat was measured using skinfold measurement at two sites, tricep and medial calf. Percent body fat was then calculated using the Slaughter et al (1988) equation. Data were analysed using univariate ANOVA, (2 X 3 X 3) with backwards elimination to achieve a parsimonious solution. Results indicate a significant main effect according to gender (F 1,776 = 61.759, p < 0.01) with boys demonstrating significantly lower body fat percentage than girls. Mean  $\pm$  S.D. of percent body fat was  $20.5 \pm 7.7\%$  and  $25.4 \pm 6.4\%$  for boys and girls respectively. A main effect was also evident according to ethnic group (F 2,776 = 6.601, p < 0.01). Tukey's HSD post hoc multiple comparisons revealed black children to be significantly

leaner than white and Asian children (P < 0.01) and white children significantly leaner than Asian children (p < 0.01). A significant 'gender' by 'ethnicity' interaction was also found (F 2,776 = 6.145, p < 0.01). White and black boys had significantly lower body fat percentages than their female counterparts. However, this pattern was not observed for Asian boys. Asian boys were found to have similar body fat percentages to Asian girls. Mean percent body fat scores for the sample and sub-samples indicate that all values were in excess of average values quoted for this population (Lohman, 1992).

The results of this study support current literature in that over fatness and obesity is a problem in British children and adolescents. In particular, the percent body fat of Asian boys is a cause for concern.

Armstrong N and Welsman J (1997) *Young People and Physical Activity*. Oxford, Oxford University Press

Slaughter M et al (1988). *Human Biology* 60: 709-723

## ABS-32

### Increased whole-skeletal muscle and single-fibre cross sectional area in body builders

**Lanfranconi Francesca, D'Antona Giuseppe, Pellegrino Maria Antoniette, Eirale Cristiano, Miotti Danilo, Moro Guido, Frascaroli Mauro, Bottinelli Roberto**

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**Keywords:** *hypertrophy, CSA, body building*

It is generally believed that muscle hypertrophy is accounted for an increase in cross sectional area (CSA) of the single muscle fibres and that an increase in the number of muscle fibres cannot occur in adult humans. The present paper aimed to examine the question as to whether hypertrophy of skeletal muscle fibre types can account for the increase in physiological CSA (CSAp) of the whole muscle.

A cross sectional study was performed comparing fibres CSA, muscle volume and muscle fibre type composition of the vastus lateralis muscle (VL) of 5 body-building athletes (bb) and 3 control subjects (ctrl). CSAp of VL was measured in vivo by using nuclear magnetic resonance (MRI). CSA of single fibres and myosin heavy chain (MHC) isoforms distribution were also determined on muscle samples obtained by needle biopsy.

The results revealed that although both whole muscle volume and fibre CSAs were much larger in bb than in ctrl, muscle volume of bb overcame what expected on the basis of the increase of single fibres CSA.

SDR Harridge et al (1996). *Pflugers Arch-Eur J Physiol* 432: 913-920

MV Narici et al (1992). *Eur J Appl Physiol* 65: 438-444

## ABS-33

### Isokinetic parameters of shoulder muscles of handball players

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**Keywords:** *handball, shoulder, muscle balance*

The shoulder joint is prone to dislocation due to poor bony fit, great range of movements and weak supporting muscles. The most important muscles group providing joint



stability is a rotator cuff group. The aim of our investigation was to determine the shoulder rotator cuff muscles strength and balance specific to handball players.

The shoulder joint motions in internal - external rotation are investigated using dynamometers system "REV - 9000" Technogym. 11 male handball players from the team of Latvian Academy of Sports Education participated in the investigation. Their mean age was  $22 \pm 2$  years, height  $190 \pm 5$  cm and weight  $91 \pm 11$  kg. All shoulder joints were injury - free. The shoulder internal and external rotation isokinetic movements were tested in the plane of scapula at slow angular velocity of movements ( $60^\circ/\text{s}$ ) and fast movements ( $180^\circ/\text{s}$  and  $240^\circ/\text{s}$ ). Then the shoulder evertors/invertors torques ratio values are calculated in the range of movements (ROM) with steps of  $10^\circ$ .

The difference between the peak torque values produced by the dominant and non-dominant arm shoulder invertors and evertors is none significant, at low and high angular velocity of movements. Respectively the significant difference is revealed between the dominant and non-dominant shoulder invertors when producing average power at high angular velocity of movements ( $240^\circ/\text{s}$ ). At lower velocity of movements ( $60^\circ/\text{s}$  and  $180^\circ/\text{s}$ ) the power asymmetry between both arms is not observed. The shoulder external/ internal rotators torques ratio for handball players in the middle part of the range of movements is close to 80% at all tested angular velocity values.

It confirms that the strength of both muscle groups increased proportionally in the training process.

*Codine P et al (1997). Medicine and Science in Sports and Exercise, Vol 29: 1400 - 1405*

*Werner SL et al (2001). The American Journal of Sports medicine, Vol 29: 354 - 358*

#### **ABS-34**

##### **Sport-is it life threatening?**

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*Keywords: sudden death, elite athletes*

Sudden death in sport is not such a rare occasion, unfortunately. Although, not every death of sportsmen is connected to sports activity, it is more likely to be an accident (as in boxing, skiing, parachuting). All the other cases of sudden death should deserve our undivided attention. In the last century sport has expanded from fun to serious business and that change led to abusing many forbidden substances in purpose of achieving the best sports result. Many articles were published about this topic, and analyses show that the cause of death changes considering age of participant in sport or recreational activity. In young participants the main cause of death is congenital malformation of the heart muscle, while in older ones it is ischemic heart disease. Analyzing CD data of 15 000 sportsmen, Olympic Gold Medal Winners, published by the IOC, we can drive a conclusion that athletes lived longer than other people of their age. For further analyses precise check up of data should be performed, as well as duration of life analyses of sportsmen after the Second World War, when elite sport has drastically changed in intensity, scope and frequency of training. In Vojvodina (2 million inhabitants), seven sudden deaths of sportsmen were registered in the last decade. These deaths took place in the sports field where activity was performed. Five of them were young people, and two were old people who

participated in recreational sport activity. Forensic report showed congenital malformation in as the cause of death of young people, and ischemic heart disease in old ones. On the basis of available data, we can not say that sport has negative effect on life duration. On the contrary, moderate sport activity is proved to have many beneficial effects on health and therefore should not be considered as a health hazard. Though, elite sport has potential harmful effects because it is connected with using maximum energetic potentials of individual, as well as with uncontrolled using of forbidden pharmaceutical substances.

#### **ABS-35**

##### **Stresses and displacements of human clavicle studied with the finite element method**

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*Keywords: finite element method, clavicle, stress and displacements*

We used the section method which divided the bone into 15 parts. A computer tomography was used for the determination of the clavicle's spatial geometry. We built the spatial model of the clavicle using the SolidWorks program. Then we used the ANSYS program for the discretisation of the bone. The spatial model of the clavicle bone was realized with tetrahedral finite elements. The bone was supposed to bend according to a normal force distributed on the lateral clavicle surface. The bone was kept in place.

We obtained the stress distribution and the displacement distribution for the entire bone. We realized that the most solicited parts of the bone, which are likely to break, are the parts from the intersection of the bone's body with its base.

The observations made by studying 37 cases of fractures of clavicle caused by the bending solicitations confirm these conclusions.

#### **ABS-36**

##### **Study of the intensity of effort in children and obese adolescents during a program of physical activities and health**

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*Keywords: obesity, children, adolescents*

The excess of weight and the obesity are some of the most important problems of health faced by children and adolescents in our society, and the intervention with physical exercises is a factor of great importance to combat the problem (Bankoff, et al 2002 e Francischi et al 2001).

The present study shows the result of physical activities realized with nine children and obese adolescents being four males (general average of Body Mass Index (BMI) of 29,07, average age of 12 years old), and five females (general average of Body Mass Index (BMI) of 26,06, average age of 10,2 years old). The aim of this study was to analyze the variables of the systolic blood pressure (SBP), diastolic blood pressure (DBP) and heart rate (HR)

in different situations such as: (pre effort, effort and post effort). The individuals were also observed in the anthropometrics parameters way in order to analyze the corporal alterations, as well as the intensity of physical effort in the walking activity, maintaining an individualized target heart rate (THR). The physical activities programs were developed in three semesters: 1st from March to June of 2001, 2nd August to November/2001 and 3rd from March to June 2002 in the Physical Education Faculty - Unicamp.

It was noticed no significant modification in the individual's anthropometrics parameters during the physical activity program. On the other hand, it was observed a significant reduction of the variables of SBP and DPB in pre effort, effort and post effort in some individuals in both sexes. It was also observed an increase intensity effort in the walking and running activities, maintaining the THR, showing an increasing aerobic capacity in all individuals.

### **ABS-37**

#### **The Internet: a major element in the professionalization of young athletes or a minor misconception of electronic researchers**

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*Keywords: young athletes, data bank, professionalization, scouting*

The internet is a major force in the professionalization of young athletes in the United States and perhaps on an international basis. The rise of recruiting web sites in all sports identifying the best and most recruitable athletes for college and university teams has risen at an amazing rate in the United States. Likewise, the establishment of data banks on athletes who attend sport skills camps, college and university sport camps, and apparel manufacturers sponsored camps are of concern to sports sociologists, professionals in the field of sport administration, and parents. While they have been a boon for college coaches, team recruiters, and other professional recruiters, the potential for problems exists at a very high level. The questions of privacy and the potential for the data bank users to exploit the information by providing mailing lists and email addresses for these athletes is a real concern.

The professionalization of young athletes in the United States is one of the major forces, along with economics and politics, effecting sports. The young athletes are joining leagues at an earlier age, being enrolled or sentenced to pre-professional sports camps, employing their own coaches for their sport specialty at an early age, and in general are starting sports participation younger than in previous years. There are financial costs and philosophical ideals from both the parent and the person in pedagogy of sport. The internet contributes to the size and scope of this problem.

In addition to scouting web sites, data banks, scholarship web sites, and other information providers, the philosophical questions have arisen of ethical behavior on the part of the webmasters and the recruiters. Young athletes are either being exposed or exploited according to the researchers in the field. Because the internet is international in scope, it is logical that these problems exist on a global level and merit the consideration of professionals in Sports Sociology, Sport Philosophy, and Sport Administration. The examination of the uses of the internet in aiding and abetting the professionalization of

young athletes is a recent phenomenon worthy of scholarly debate and further research.

### **ABS-38**

#### **The measurement of anaerobic capacity in disabled swimmers**

**Szmatlan-Gabrys Ursula, Gromisz Wilhelm, Plewa Michal, Nowak Zbigniew, Gabrys Tomas**

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*Keywords: anaerobic capacity, disability swimming*

The assessment of force developed by a swimmer in water has been so far analyzed from biomechanical point of view. Physiological analyses did not include measurement of the swimming force. (Toussaint H, Beek P. 1992). The purpose of this study was to show, that the measurement of the swimming force during 60-second intensive work may be useful in assessment of anaerobic capacity.

The study group consisted of 23 disabled swimmers (10 men, 13 women). Recording of force during swimming performed at maximum intensity within 60 sec. was conducted with the use of MAX-5 kit (converter of non electric values sending out a signal to a tens metric amplifier connected with a computer). The following parameters were measured: heart beat (HR, Polar Team System) and lactate (LA) measured before and after exercise in 4th, 8th and 12th min. Swimmers' anaerobic capacity was also assessed with the use of 6x50m interval swimming test. The results were subjected to statistical analysis.

There have been four zones of specific energetic source identified in the course of the force curve: 1- ATP-PCr(5-7s); 2 - glycolytic anaerobic power (5-10 s), 3 - glycolytic anaerobic capacity (10-40 s), 4 - anaerobic-aerobic capacity. The force in each energetic zone showed the correlation with speed of the first 50 meters of swimming test ( $r=.793$ ;  $r=.848$ ,  $r=.870$ ;  $r=.790$   $p<0.001$ ) and of the fourth zone ( $r=.600$ ;  $r=.688$ ,  $r=.761$ ,  $r=.703$   $p<0.001$ - $p<0.01$ ). LAmx after 60 seconds of work and 6x50m test showed correlation of  $r=.712$ ,  $p<0.001$ . The following regression equations between HRmax (60-s) and HRmax (for consecutive 50-meter distances) were calculated on the basis of recorded HR:  $y=0.3237x+114.43$ ;  $y=0.3225x+119.86$ ;  $y=0.3483x+118.11$ ;  $y=0.3515x+120.1$ ;  $y=0.6839x+65.128$ ;  $y=0.3675x+121.72$ ; ( $p<0.001$ ).

The 60-second work with the measurement of the force meets the requirements of the test assessing swimmer's anaerobic capacity. Discovered variability of correlation of parameters describing intensity of work (strength – time), glycolysis intensification, (LA) as well as stressing of cardiovascular system (HR) confirms our assumptions.

*Toussaint H., Beek P. (1992). Sports Med.13:8-24.*

### **ABS-39**

#### **The system of facilities and condition of PE in schools with a majority of gypsy students in baranya country**

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*Keywords: physical education, education, disadvantaged minorities*

The results of teaching PE as a subject depend on several factors. Effective curricula, highly educated and well trained PE teachers and appropriate facilities are required.

The focus of attention is concentrated on these issues concerning the schools with a majority of gypsy students in Baranya County, Hungary. Several contradictions and problems of the students of gypsy origin are to be solved in public education as well. In our opinion, PE can be one of the subjects in which reducing the disadvantages of handicapped gypsy students and their integration can be solved. The aim of this investigation is to assess the facilities and conditions in the schools with a majority of gypsy students in Baranya County, Hungary. The following issues are included in the investigation:

Subjective facilities: the distribution of PE teachers according to their pedagogical qualification(s); the distribution of PE teachers according to their PE qualification(s), revealing the work conditions of PE teachers, etc.

Objective facilities: the quality and utilisation of facilities of the institutes; the physical, hygienic and cultural conditions in the institutes.

Questionnaires including open and closed questions were completed by the headmasters and the PE teachers at the schools participating in this investigation.

All the schools with a majority of gypsy students in Baranya County were included in this investigation. Therefore, the investigation can be regarded as representative and significant. The data obtained in the course of the investigation was sent to the education committee of the local governments and the gypsy local governments in the county. Having this overall picture, the local governments can make their plans concerning their future developments. We are ready to share the data and experiences of the investigation with the schools concerned, and we offer further cooperation as well.

The investigation proves that the achievement of students at school significantly depend on their social and cultural backgrounds. We regard this investigation as a contribution so that, first of all, PE as a subject should be capable of counterbalancing these unfavourable disadvantages of handicapped students.

#### **ABS-40**

##### **Thoughts and acts - lifestyle of university PE students in focus**

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*Keywords: physical activity, lifestyle, physical education students*

The number of PE lessons at schools has decreased since the decentralized curriculum of 1998 was introduced in Hungary. We regarded this decision as wrong in the knowledge that the young people of school age are in poor state of health. It is supposed that the decrease in the number of PE lessons make their chances of healthy physical development and the development of their motor capabilities worse. This study investigates the knowledge related to lifestyle and the current lifestyle of the PE students beginning their studies at the university in 2001 and in the following years onward, who have participated in the courses in accordance with the new curricula. The aims of study -- to obtain an overall picture of the lifestyle and habits of the PE students studying at the university; with particular attention to PE training and sports; -- to gather information about their knowledge related to healthy lifestyle and its application to practice.

The study includes 73 PE students in 2001 and 110 PE students in 2002. The questionnaire includes the following

main questions: -- How long time do you spend learning, doing sports, enjoying leisure time and amusement? -- What dominant leisure-time activities do you have? -- What sporting habits have you acquired? -- What harmful addiction(s) do you have? -- What diet do you have? -- What schedule have you set up consciously to maintain your physical fitness? -- What is your opinion about the interrelationship of regular physical activities and healthy lifestyle?

On the basis of the data obtained, harmony and disharmony between thoughts and acts have been revealed. These results are significant because they do not provide information merely about the future of intellectuals, but they do provide us with information about the lifestyle and related habits of the would-be sport experts and PE teachers. In the strategy of PE teacher training, physical education plays a significant role in forming lifestyle.

On the basis of the revealed phenomena, it becomes possible to make recommendations concerning the PE subject that can have a positive effect on the students, the would-be adults.

*Andorka R (1998). Bevezetés a szociológiába*

*Földesiné SG (1985). Sport a változó világban*

#### **ABS-41**

##### **Women in recreation sport in Pecs**

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*Keywords: physical education, curriculum, pedagogics*

Recreation can be regarded as the culture of quality of life. This notion of recreation has been accepted in Hungary with some difficulties. Even today, recreation may be interpreted differently by participants in a debate. Recreation may suggest notions such as adventure sport, unique sport, differences in sport. There are difficulties not only with the interpretation of the notion but we may have difficulties with the practical activities associated with it. Although the number of people pursuing leisure-time sports increases, and we have a wider and wider range of choice, we can have some reasons for anxiety. Our way of life does not reflect values of health. Statistical reports suggest a sick society. The underlying problems to be taken care of urgently can be resolved only by a complete social cooperation including the full participation of sport experts and PE teachers.

We were motivated to choose this topic by the above mentioned situation. We have attempted to assess what natural and social facilities the population of Pécs are provided with, and who make use of them. The assessment has shown that women are more active. Therefore, we have studied women's participation only.

The aim of study: 1. Facilities and opportunities of sport-recreation provided for the population of Pécs. 2. Information about the participation of women in the activities of sport-recreation. 3. Setting up a top-list of motivations. 4. Comparison of the results obtained by our assessment and similar assessments carried out in Western European countries.

Number of participants in the assessment: 250; Method of gathering data: interviews, questionnaires; Method of processing data: After coding the data, they were checked and loaded into computer. Data analysis was performed by SPSS programme.

-- An overall picture was obtained of the facilities of sport-recreation.

- The highest number and best organized opportunities of different gymnastic activities accompanied by music are provided for women.
  - We succeeded in obtaining information about the motivations of different participating age-groups, etc.
- The presentation of the results is supplemented with recommendations for sport expert education and training.

#### **ABS-42**

### **Differences between basketball teams which competed at the 19th and 20th European championships for male juniors in number of attacks and playing efficiency**

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*Keywords: basketball*

In 2000, some articles in the basketball rules changed. The crucial changes were the shortening of time for passing the ball to the frontcourt from 10 to 8 seconds and the shortening of time to attack from 30 to 24 seconds. We were interested whether the changes reflect in a higher number of attacks and playing efficiency of the teams.

The sample included 12 national teams, participating at the European Championships for junior men in 2000 (the previous Rules applied) and in 2002 (the new Rules applied). At both championships the teams played 46 matches and the competing system was equal. The sample included five variables: number of scored and received points, number of attacks, percentage of goals scored from field and free throws and number of turnovers. The data was analysed with one-way analysis of variance. It was established that the average number of attacks per match at EC 2002 (89.4) was statistically significant higher than at EC 2000 (80), consequently the time to attack shortened (EC 2000: 15.0 sec; EC 2002: 13.4 sec). At EC 2002 the absolute playing efficiency was higher and statistically significant in offence (75.4 points), while at EC 2000 it was in defence (69.1 points). The percentage of field goals (45.3 - EC 2000; 43.3 - EC 2002) and free throws (70.7 - EC 2000; 68.1 - EC 2002) was quite similar at both ECs. The same applies of the number of turnovers (14.9 - EC 2000; 14.2 - EC 2002). The differences are statistically insignificant.

Based on these results it may be concluded that at EC 2002 basketball was played faster and it became more attractive to the spectators. The absolute playing efficiency in offence increased, while the relative efficiency remained the same, despite faster playing. The changes in the Rules served their purpose.

*Dezman B, Tkalcic S (2002). Kinesiology, 34(2): 2-11.*

## List of Authors

### A

Aaberge	446
Aadahl	152, 172
Aagaard	18, 50, 178, 182, 206, 222, 347, 434
Aandstad	381
Abdul	167
Abel	113
Abigail	314
Abo	81
Abrahamyan	113
Achten	209
Adomaitiene	20, 425
Ageli	448
Agha	185
Ahtiainen	132, 375
Ahtikoski	186
Aigner	381
Aimet	396, 403, 411
Airaksinen	148, 354, 402
Aird	433
Akimoto	95
Akova	404
Alberti	61, 282
Aldrian	221
Aleksandraviciene	95
Alen	55, 268, 354
Al-Hazaa	395
Alichmann	91
Allard	136, 235, 236, 307
Allerlei	398
Allison	24
Allmer	14
Al-Nakeeb	102, 278, 432, 475
Alt	124, 128, 148, 223, 224
Altimari	267, 460, 461
Alves A	469
Alves F	270
Alves L	412
Amann	178
Amaoka	75, 81, 397, 402, 403, 411
Amendoeira	60
Amesberger	215
Amici	119
Amundsen	354
Andersen J	169, 178
Andersen L	178
Andrade D	268, 447
Andrade E	268, 447
Andrade R	412
Andreana	293
Andrijasevic	449
Andrzejewski	400
Angiari	232
Ángyán	68, 225, 267, 434
Antonakis	160
Antoniale A	124, 417, 467
Antoniale L	417, 467
Antoniou	120
Antonogiannakis	97
Antonutto	47, 155
Antunes	101, 117
Aoba	248
Aoyama H	265
Aoyama T	248
Appleton K	444
Appleton R	301
Ara	408
Aragon-Vargas	324
Arampatzis	48, 154, 193
Araújo	104, 268, 447
Ardelt-Gattinger	14, 266, 441
Arkinstall	184
Arndt	36
Arngrimsson	470
Askew	183
Astratenkova	454
Astrup	28
Atalay	452
Atali	99
Atzor	378
Audran	245
Ausenka	447
Avela	174, 205, 328, 347, 388
Avigliano	87, 320, 321
Avogadro	47, 132
Avogaro	253
Azevedo	288
<b>B</b>	
Baar	31
Baca	189, 191, 306, 342
Bacharach	210, 250
Bachev	64
Bachl	400
Backer	19
Baeyens	42, 127, 366
Baggio	242
Bahr	195, 337, 355
Baião	285
Baik	81
Bailo	20
Bakovic	260, 406
Balague	171
Balestreri	16, 85
Balogh	66
Baltzopoulos	390
Bamac	99
Bankoff	137, 267, 460, 461, 476
Banzer	66, 398, 399, 402
Baptista	440
Bara	99
Barabás	130
Barak	106, 248, 249, 252, 256, 269
Barbosa J	79
Barbosa T	55, 127
Barney	180, 188
Baroffio	212
Baroni	365
Barrigas	271
Barros R	102
Barros T	67
Barry S	183
Barry St	227
Barstow	340
Barthélémy	84
Baskin	244
Bassa	348
Bassani	168
Battenberg	163, 418, 424, 473
Baubliene	105
Baudry	25
Bauer	243, 338
Baur	129, 302, 385
Bayios	129, 274, 346, 465
Bazzucchi	76
Bebetsov	120
Becker D	140
Becker H	213
Bedu	271
Beetz	229
Belaieff	25
Belavary	477
Belli	47, 48, 49, 56, 129, 132, 155
Benc	265
Bencke	347
Benedito-Silva	92
Beneke J	297
Beneke R	84
Benelli	76, 233, 407
Benestad	391
Benhamou	37
Benicio	103
Benito	313
Bentley	177, 340
Benvenuti	119, 279, 432
Berahmandpour	457
Berg	15, 90, 321, 327
Berger	22
Bergersen	390
Berget	18
Bergmann	357
Berme	21
Bernard	201
Bertollo	333
Berton	61
Bertuzzi	371
Bessot	128
Beuttler	369
Beyer	19, 170
Bhambhani	392
Biasin	374
Biddle	45
Bigon	253
Billat	168
Birch	367
Birk	347
Birken	259
Birzinyte	126
Bishop D	28, 52, 72, 74, 100, 206, 259, 319
Bishop S	314
Bjarnason-Wehrens	220, 435, 474
Blanco	231
Blazquez	165
Blickhan	171
Blum	63, 319
Bockrath	222
Boehlke	165
Boese	50
Bogner	65
Böhm	366
Boirie	96
Bolanowski	400
Bon	120
Booth	9, 138, 186
Borg	156, 446
Borghetti	283
Borkenstein	376
Boros	109
Borrani	156, 381
Borsheim	337
Borysiuk	176, 269
Bosch	77
Bosizio	472
Boskovic	106, 248
Bosnar	310, 311
Bosse	377
Botelho-Gomes	470
Bottas	223
Bottinelli	260, 475
Bouckaert	72

Boudolos	126, 129, 346, 388	Caporossi	320, 321, 453	Coen	228
Bourdin	26, 132	Cappellin	87, 187	Cogo	374
Boussuge	271	Cappozzo	20	Coh	133
Bouter	355	Capranica	119, 168, 241, 281	Colaço	285
Bouziotas	448	Cardinale	217	Colak	99
Bown	289	Carey	208	Colantonio	141
Boyer	153	Carlsen	277	Colman	330
Bozic	248	Carmeli	186	Colombani	104
Brackenridge	147	Carnevale	239	Colombini	80
Bragada	238	Carraro	212	Colombo	302
Braggion	268, 447	Carrero	266	Comparoni	92
Braña	226	Carroll R	421	Connes	245
Branco	91	Carroll T	181	Cooper	123
Brandão D	427	Carson	181	Cordain	463
Brandão E	241, 412	Carter	29	Corradini	41, 472
Brandauer	113	Cartoni	120	Corrêa	458
Brandes	295	Carvalho	106	Côrte	142
Brandl	396, 411	Casazza	158	Côrte-Real	283
Braumann	313	Castell	35	Costa	109
Bredariol	412	Castro	460	Cotelli	365
Brehm	151	Catani V	87, 320, 453	Cottet-Emard	85
Breivik	309	Catania C	419	Cottyn	331
Brettmann	398	Cattrysse	42, 127, 366	Coudert	57, 85, 459
Brettschneider	38	Cautero	237	Courteix	37
Bretz	435	Cavala	58, 123, 221	Courtine	23
Brewin	316	Cè	32	Cox	196
Brich	104	Ceci	87, 320, 453	Cramer	206, 390
Briem	470	Cecic	287	Creveaux	25
Brisswalter	52, 100, 201	Ceddia	364	Crombez	331
Broad	457	Cevese	16, 85	Crova	242
Brocca	260	Chacon-Mikahil	267	Cruz	430
Brooks C	301	Chan P	86	Cumps	168
Brooks G	158	Chan W	119, 421, 422	Cunha A	469
Brüggemann	48, 154, 193, 217, 315, 365	Chang C	200	Cunha e Silva	142, 283
Bruhn	40, 178, 223	Chang E	343	Cunha L	134
Brunetti	242	Chang H	285	Cunha M	82
Brunner	114, 172, 274, 455	Chapman	254, 368	Cura J	241
Bubeck	392	Chatagnon	56, 255	Cura P	241
Budde	254	Chaux	47, 132	Curda	358
Bueno	101, 117	Chavarren	408	Cybulski	36, 377
Bühlmeyer	105	Che Muhamed	244, 401	Cyrino	267, 460, 461
Bunc	15, 234, 290, 292	Chen	87, 254	<b>D</b>	
Bundzen	412	Cheng	35	Da Costa	283, 289
Burgardt	304	Cherkas	353	Dahl D	294
Burini	461	Chevalier	210	Dahl E	300
Burke	451	Chew	315	Dalgas	18
Bürklein	399	Chi	329	Dancs	277
Burluc	121	Chida	34	Danilowicz	410
Burniston	28	Chill	371	Danné	419
Burtscher	30, 139, 250, 274, 373, 408, 455	Chisamore	343	Dantas	431
Busso	56, 255	Chow	86	D'Antona	260, 475
Buyl	127	Christensen L	178	D'Artibale	242
Buyse	200, 436	Christensen M	143	Dauvilliers	435
Byrne	315	Christenson	240	Davenne	128
<b>C</b>		Christodoulos	445	Dawson	206
Cabri	42	Christou	160, 438	De Anna	419, 428
Caillaud	245, 435	Chua	277	De Boeck	123
Calbet	408, 436	Ciafrè	321	De Bosscher	146
Calderón	313	Ciddio	281	De Bourdeaudhuij	214
Calixto	462	Cieslak	99	De Clercq	331
Callow	108	Cillik	234	De Geus	200, 436
Calu-Leoca	116	Ciocanescu	437	De Jaegher	72
Calvo	165	Claasen A	77	De Jager	52
Campbell A	145	Claasen M	331	De Knop	146
Campbell I	383	Claessens	449	De Martelaer	146, 413
Camy	385	Clarijs	42, 127, 366	De Meirleir	200, 436
Canclini	365	Clark	28	De Mello	92
Candau	381, 435	Clarys	92, 269, 457, 460, 461	De Monte	48, 154, 365
Cândido	274	Clausen	70, 71, 73, 360	De Oliveira	336
Cankar	414	Clénin	375	De Palo C	87
Cannon	125, 205, 304	Clijssen	92	De Palo E	87, 187
Capelli	237	Clottes	57	De Perini	321
Capodaglio	80	Cochrane	340	De Pero	119
		Cociorvei	99	De Potter	214
		Coelho	461	De Schutter	200, 436
		Coelho e Silva	60, 228		

De Vito	44, 76, 77	Duda J	385	Fernandez-Garcia	249, 433
Dedecker	461	Dudycz	234	Fernhall	43
Deibert	15	Duffield	206	Ferrão	60
Deiuri	47, 155	Dujic	260, 406	Ferrario M	472
Deley	90, 156, 175, 381	Dumitru B	121	Ferrario V	135
Delheye	189	Dumitru C	288	Ferrauti	69
Demeter	273, 478	Duncan	102, 278, 432, 475	Ferreira A	335
Demirhan	393	Dunphy	280	Ferreira C	271
Den Ouden	366	Durakovic	416	Ferreira D	263
DePauw	350	Duranti	87, 320, 453	Ferreira J	104, 263
Derbaudrenghien	72	Duus	18	Ferreruela	297
Deriemaeker	92, 457, 460, 461	Dvorak	42, 92	Ferri	80
Derijcke	460	Dyhre-Poulsen	39	Ferro	297
Derycke	49	Dyrstad	381	Feu	190, 428
Desbrow	456	Dzuvo	257	Figueira	412
Devecerski	270	<b>E</b>		Figueiredo A	60, 228
Devonport	332	Eaton	463	Figueiredo An	394
Dezman	290, 292, 466, 479	Eaves	431	Figueiredo P	80, 456
Di Cagno	242	Eberspächer	216	Figura-Chmielewska	410
Di Prampero	47, 155, 237, 322	Ebert	362	Filipovic	248, 256
Di Russo	310	Edamatsu	247	Findak	416
Dickhuth	321, 351, 385	Edelmann-Nusser	130, 302	Fisberg	442
Didu	136, 307, 476	Eder	189	Fischer A	191
Diederichsen	39	Edge	28, 52, 72	Fischer C	77, 208, 320
Diel	207, 360, 455	Edwards	362	Fisher M	51
Diemont	32	Effenberg	196	Fisher R	39
Dierk	266	Eggert	278	Fitzsimons	61
Diketmüller	145, 445	Eibl	264	Fjeld	391
Dillias	104	Eirale	260, 475	Flanagan	184
Dimitriou	167, 293, 294	Eisenburg	52	Flatz	30, 408
Dineli	361	Ekler	420, 423	Floria	297
Diniz	460	Eklund	112	Flouris	99, 177, 261, 433, 474
Dinold	212, 213	Elferink-Gemser	143, 161, 226	Flyvbjerg	28, 154
Distaso	232	Elling	17	Fogarasi	65, 413, 415, 417, 466, 473
Ditroilo	76, 233, 407	Ellingsgaard	434	Fogelholm	55, 156, 446
Divert	47, 129	El-Sayed	88, 209	Fonda	254
Djobova	214	Embersic	236	Fontes	267
Djonov	140	Emrich	228	Fontes Ribeiro	79, 260, 394
Djordjevic	161, 329	Engel	197	Forsythe	61
Dolch	122	Engelmann	36	Foss	33, 360, 394
Dolenec	49	Engström	146	Foster C	178, 384
Domaradzki	401	Enoksen	340	Foster D	115
Dondukovskaya	459	Ensenyat	231	Fournier	74
Dong	440	Era	18, 471	Fox	144
Dongming	452	Erculj	120, 290, 292, 466, 479	Fragoso	271
Donne	227	Erdinc	89	Franchini	371, 460
D'Onofrio	430	Esaki	102	Franco C	462
Donsmark	11	Esfahani	438	Franco S	419
Dorado García	408, 436	Esmarck	205	Franke	66
Dordel	220, 435, 474	Espanha	91	Frankowski	359
Dorel	26	Estermaa	117	Franks	277
Dorman J	257	Esteves	92	Frascaroli	260, 475
Dorman R	453	Eterovic	260, 406	Fredel	345
Dorogi	118	Ettema	57, 110, 379	Fredsted	71, 73
Doru	121	Evans	170	Freeman	220, 423, 468, 477
Doschak	43	Ewald	302	Freund	364
Douda	98, 438	<b>F</b>		Frey	15
Doupona	287	Faff	79	Frick	163, 418, 424
Dourado	64, 239	Fagard	326, 352	Friedel	207
Dousset	174, 205, 328, 347, 388	Faina	203	Friedrich A	69
Dräger	259	Faist	22	Friedrich T	113
Dragomir	124	Famisis	177	Friis	222
Draper	27	Farace	321	Frisselli	64
Drapsin	106, 249, 252, 256, 268	Faradjzadeh	78, 407, 464	Fritz	358
Draskovic	476	Farahpour	136, 235, 236, 307	Froberg	173
Drazdauskas	447	Faro	55	Fröhlich H	173
Drazeta	257	Fasting	146, 147	Fröhlich M	228
Drobnic	405	Faude	371	Fromme	35, 140
Drost	132, 186	Faulhaber	30, 408	Frost	99
Dryukov	58	Favier	61	Fruhwald	83, 448
Du Toit	356	Febbraio	208, 320	Fuchs	144
Duarte	456	Felici	76	Fujimoto H	12
Dubininkaite	81, 200	Fellmann	57, 85, 459	Fujimoto K	411
Duchateau	25	Fernandes	431	Fujimoto S	263
Duché	96, 271	Fernandez	442	Fujimoto T	13, 34
Duda G	21				

Fujiwara	263	Gošnik	311	Hanghoj	168
Fukashiro	128	Goto	318	Hanin	338
Furler	152	Gouard	61	Hänni	357
Furuna	102	Goubel	125	Hänninen	452
Fyodorov	112	Gouvali	388	Hannonen	354
Fyodorova	112	Grabow	319, 374	Hanon	255
Fysh	382	Graça	426, 427, 428, 429	Hansen H	205
<b>G</b>		Graf	220, 435, 474	Hansen M	28
Gäbel	345	Graichen	357	Hansen T	71
Gabor	353	Granacher	174	Haouzi	341
Gabrys	229, 409, 474, 477	Grassi B	80	Hara H	75
Gaderi	94	Grassi G	135, 302, 472	Hara T	263
Gadina	61	Grecu	136, 307, 476	Haraguchi	439
Gajer	255	Green	393	Hardy	459
Galbo	11	Greiderer	262	Hare	389
Gallagher	340	Greie	378	Hargreaves	456
Galli	407	Greig	61	Harkrider	37, 62
Galloway S	114	Greiter	15	Harley	395
Galloway St	457, 458	Grélot	84	Harridge	138, 169
Galm	398	Grey	22	Hartman	364
Ganter	130	Griffith	37, 62	Hartmann	97, 202, 229, 231, 243, 304, 338, 374
Gara	448	Grobler	314	Hartmann-Tews	17
Garcia	423	Gromisz	477	Hartung	69
García	313	Grözinger	187	Harwood	192
García-Manso	75	Grubb	340	Hatting	222
Gardner	362	Gruber	124, 223	Hatziharistos	220
Garland	226	Gruender	370	Hatzikotoulas	348
Garrido	106, 275, 442	Gruic	227	Haug	337
Gasiorowska	377	Grujic	249, 256, 265, 476	Hausberger	358
Gassi	267, 460, 461	Grzywacz	75	Hausswirth	52, 100
Gassmann	140	Guedes	447	Hautala	291, 352, 353, 369
Gatti	87, 187	Guette	243, 368	Hautier	26
Gauthier	128	Gueux	459	Havas	73, 207
Geisert	130	Guglie	453	Hawkins	368
Geladas	59, 177	Guler	243	Hay	99
Georgiadis	70, 242	Gullstrand	33	Hayashi Ka	12
Georgiev	64	Gunga	378	Hayashi Ko	81
Gerber	162, 426	Gur	89, 404	Hayashi S	397, 402
Gesuale	233	Gurd	261	Haydn-Davies	163
Geyssant	49	Gurzi	300	Hebbelinck	92, 457, 460
Ghanbari	276	Gyimes	353	Heck	374
Gharakhanlou	185	Gyliene	419	Heer	50
Ghazaleh	307	Gylterud	390, 391	Heigenhauser	11
Giacomini	407	Györe	346	Heijboer	86
Giakas	135	<b>H</b>		Heikkilä	132, 454
Gieß	451	Ha	162	Heim	163, 197, 418, 424, 473
Giggel	345	Haag	141	Heimer	90
Gilbourne	363	Haas C	384	Hein	164
Gioga	452	Haas H	224	Heinemeier	154, 204
Giovanna	282	Haber	161, 262, 434	Heinen	198
Gissel	71, 73	Hadji Rasouli	111	Heinicke	140
Gissis	230, 467	Haga	102	Heinrich	63, 319
Glaner	274	Hagströmer	24	Heinrichs	34
Gleeson M	196	Haguenauer	25	Heinz	356, 440
Gleeson Mi	314	Hahn	298	Helge	386
Glotov A	187, 453	Haid	262	Helgerud	160, 354
Glotov O	187, 453	Hajduné	273	Heller J	62, 246, 292
Gobbo	32	Haji	167	Heller M	302
Godinho	278	Häkkinen A	148, 354	Heller Ma	21
Goedecke	77	Häkkinen K	55, 132, 181, 268, 291, 354, 375	Hellstern	224
Golberg	86	Halcomb	37, 62	Hemmings	114
Goldspink	28	Hall C	215	Hencken	259, 296
Golenia	14	Hall M	301	Herde	244
Gollhofer	40, 44, 57, 124, 128, 148, 174, 178, 223, 224, 385, 392	Hall R	332	Herlicska	273, 414
Gomes	458	Hallén	33, 360, 375, 381, 390, 391, 394	Herno	148
Gomes-Pereira	270	Halsen	218	Herodes	275
Gonçalves	134, 335	Halstenberg	36	Herzog	379
Gondin	243, 368	Hämäläinen	393	Hessel	362
Gonener	99	Hamaoka	73, 183	Hesselink	132, 186
Goodman	28, 52, 72, 206	Hamar D	351	Hideki	272, 440
Goosens	123	Hamar P	285	Higuchi M	82
Goris	366	Hamilton-Wessler	368	Higuchi T	12
Gorner	464	Hamzah	450	Hill	37, 62
				Hille	266
				Hirayama	256



Hiroko	443
Hirschmüller	129, 302
Hiscock	320
Hjdné László	414
Hodapp	22
Hödl	448
Hoff	160, 354, 363
Hoffman	86, 87, 244, 401
Hoffman-Goetz	364
Hoffmann A	312
Hoffmann U	139, 259, 407
Höfling	41
Hofmann	83, 84, 191, 237, 251, 280, 313, 384, 400, 448
Hofstetter	66
Hogenova	293, 385
Hohmann	191, 334, 345
Holliday	297
Hollmann	220
Holloszy	31
Holm C	11
Holm L	205
Holmberg	336
Holviala	268
Holzer	229
Homma	73, 183
Hong	421
Hongsoo	184
Honl	266, 357, 358
Hood	32
Hoppeler	210
Horci	234
Horning	158
Horstmann	358
Hörtnagl	262, 264, 437
Hoshijima	397, 402
Høstmark	337, 355
Hottenroth	345
Hotter	274, 455
Houlton	469
Hovanloo	78, 407, 464
Hrabak	187
Hsuuw	200
Huang S	35
Huang W	329
Huber	298
Hughes A	145
Hughes M	123, 301, 431, 469
Huikuri	352, 353, 369
Humble	306
Humphreys	449
Huttunen	199
Hyatt	111, 220, 477
Hydal	71

## I

Ibáñez	190, 428
Ibrahimbegovic-Gafic	68
Ichikawa	179
Ichimura	73, 183
Ida	439
Iellamo	326
Igne	460
Iida	247
Ijiri	437
Ikiviranta	148
Ilic	118
Immenroth	216
Impellizzeri	240, 282, 318, 363
Inbar	252
Inglis	433
Inoshita	89
Isao	440
Ishii K	13, 34
Ishii Ky	397, 402
Ishikawa	174, 205, 328, 347, 388

Ishimoto	75, 397, 402, 403, 411
Ishizuka	134, 299
Isolehto	40, 365
Ito	252
Itoh H	439
Itoh M	13, 34
Ivanov	190, 426
Ivashchenko	187
Iwatake	305

## J

Jacobsen	18
Jaffré	37
Jäger	370
Jaitner	224
Jakobs	69
Jakovljevic	113
Jamurtas	249, 390, 424
Janeira	241, 412
Janssen	380
Jansson	434
Jaszczur-Nowicki	88
Jauffred	208
Jeannin	48, 49
Jentjens	325
Jereb	223
Jeschke	243, 338
Jeukendrup	29, 209, 325, 361
Jiménez-Ramírez	436
Jimmy	152
Johannsson	470
Johns	162
Jones A	72, 383
Jones D	29
Jones N	289
Jordan	379
Jordet	332
Jørgensen K	19
Jørgensen T	152, 172
Joseph	32
Joubert	77
Jovanovic	64, 282
Jovanovic-Stojkovic	261, 475
Jukic	230
Junbiao	452
Jung	473
Junge	42, 92
Jürgens	304
Jürimäe J	83, 94, 258, 275
Jürimäe T	83, 232, 258, 275, 415
Juvani	291

## K

Kaarma	238
Kaciuba-Uscilko	36, 377
Kaczmarek-Kusznierewicz	75
Kaelin	148
Kainulainen	207, 454
Kalem	187
Kalinski	208, 453
Kallio J	174, 205, 328, 347, 388
Kallio M	352
Kalliokoski	71, 79
Kalous	290
Kamibayashi	240, 256
Kamimura	66
Kaminsky	353
Kamohara	89
Kandare	411
Kaneko	318
Kanervo	298
Kanwar	126
Kaprio	162
Kapus	257
Karaba	249, 476
Karamanidis	48, 154
Karamouzis	98

Karl	124
Karras	465
Karsai	225, 267
Karstens	67
Karteroliotis	446
Karu	415
Kashef	356
Katona	430, 472
Katsumura	73, 102, 183
Katz	343
Kautiainen	148, 162
Kavaliauskas	447
Kawanishi	89
Kawasaki	66
Kay	125, 205, 304
Kayser	373
Kehl	357
Keller C	77, 208
Keller P	208
Kellis	230, 467
Kellmann	109
Kemi	160, 354
Kemp	184
Kempnaers	200, 234, 436
Kemppainen	13, 71
Kerner	311
Kersevan	329
Kerwin	315
Kettunen	251
Kezele	199
Khan	108
Khanna	452
Khazayi	438
Kiil	390
Kijin	184
Kilding	382
Kime	183
Kindermann	371
King	165
Kingman	296, 408
Kinguasa	102
Kinnunen	369
Kipp	451
Kirk	51, 145
Kirschner	428
Kiss M	141, 371
Kiss R	346
Kiss S	68
Kitada	13
Kitahara	73, 183
Kivelä J	291
Kivelä R	73, 207, 454
Kiviniemi	291, 352, 353, 369
Kiviranta	18, 40, 397, 471
Kizaki	102
Kjær	18, 19, 28, 50, 154, 186, 204, 205, 206, 222, 347, 350, 390, 434
Kjeldsen-Kragh	195
Kjendlie	134, 387
Klánová	399
Klarlund-Pedersen	77, 195, 208, 219, 320, 337, 463
Klass	25
Klausen	178
Klein	83, 448
Kleindienst	322
Kleinert	14
Kleinöder	377
Klentrou	99, 261, 433
Kleshnev	131
Klestil	358
Klippel	220
Klisch	22
Klissouras	59, 330
Klose	113

Klous	344	Krug	309	Lau	312
Knapen	144	Krüger	345	Laudenklos	69
Knigge	14, 100	Krustrup	33, 360, 394	Laukkanen	291, 383
Knoll K	317	Kryger	169	Lauro	412
Knoll Z	346	Kubota	13	Lavender	13, 93
Knudsen	222	Kucukalic-Selimovic	257	Lawrence	108
Knuth	70, 107, 231	Kucukoglu	404	Lawton	362
Knuuti	13, 71, 79	Kudo	266	Lazaar	271
Kobuszezewska-Chwirot	410	Kudou	248	Lazzer	96
Koca	393	Kuehne	379	Lebed	334
Koch	220, 435, 474	Kugovnik	295	Lebenstedt	50
Kocsis	346	Kuitunen	174, 205, 327, 328, 347, 388	Lechtermann	140
Köhler M	251	Kujala U	162, 402	Ledl-Kurkowski	381
Köhler S	359	Kujala V	441	Lee H	95, 362
Kohno	66	Kukkonen-Harjula	156, 446	Lee Y	329
Koivukangas	348	Kullmann	178	Lee-Hsieh	200
Koka	418	Kulnazarov	190, 426	Lees	295
Kokalas	455	Kumagai	444	Lefevre	214
Kokubun	37, 62	Kumagawa	124	Legreneur	25
Kolb	445	Kun	235	Lehénaff	255
Koller	262, 264	Kuno	256	Lehnen	97, 202
Komi	19, 21, 40, 128, 148, 174, 199, 205, 223, 298, 327, 328, 347, 365, 388	Kuntz	451	Leirdal	57
Komkova	454	Kunze	27	Leitão	442
Komulainen	132, 186, 454	Künzell	197	Leitner	191
Kongsgaard	19	Kuo	97, 398	Leko	56, 228
Konieczka	319	Kurakake	12	Lemberg	415
König B	15, 90, 327	Kuribayashi	444	Lemmink	143, 161, 226
König D	321	Kurkevych	258, 353	Lemos	287
Kono	95, 256	Kurosawa	73, 183	Lemyre	333
Kontogianni	446	Kusch	407	Lénárt	116
Koopman	246	Küster	289	Lenoir	49, 331
Kopp	343	Kyröläinen	71, 174, 205, 253, 328, 347, 388	Lepers	26, 90, 175
Koppo	72, 383			Lepola	40
Koralewski	378	<b>L</b>		Leppänen	73
Kornecki	300, 410	La Rocca	428	Leppik	275
Korneva	454	La Torre	61, 282	Leskosek	254
Kornexl	274, 455	Laakso	38	Letic	269, 270
Kornfeind	189, 306	Laaksonen D	452	Leung	86
Kororos	274, 465	Laaksonen M	71	Levai	318
Kosaka	75, 81, 397, 402, 411	Lacerda	142, 283	Leveque	201
Koskel	238	Lacour	26	Levy	343
Koskelo	51	Lacroix	442	Leyk	139
Koskinen K	41	Ladyga	79	Li	422
Koskinen S	186, 204, 390	Lagerstroem	100	Likar	139
Kossiva	220	Lais	40	Lim	315
Kösters	172, 345	Laitinen	74	Limonta	472
Kotake	139	Lakatos	267	Lin	97, 398
Kotzamanidis	348	Lalyko	113	Lindeberg	463
Kotzian	396, 403, 411	Lamas	239	Lindenhofer	127
Kouli	120	Lamb	449	Lindinger	336
Koutedakis	177, 249, 390, 424, 448	Lambert	77	Lindner	369
Koutouloulis	274, 465	Lambertz	125	Link	190
Koutsioras	135	Lames	190, 290, 342	Linnamo	174, 205, 223, 328, 347, 388
Kouvelioti	467	LaMothe	43	Linne	253
Kovac	265	Lancerin	87, 187	Linnovaara	19
Kovacic	466	Lanciotti	419	Lipfert	160
Kovacs	327	Landmann	15	Liphardt	154
Koval	88	Lane	215, 332	Lippke	144
Kovalenko	453	Lanfranconi	80, 260, 475	Liu J	246
Krabbe	322	Langberg	154, 204, 222, 390, 434	Liu L	12
Kraemer	55, 132, 268, 375	Lange	259	Liu Yeu	309
Kragh-Kjeldsen	337	Langevoort	92	Liu Yu	329
Krämer	70, 107, 129, 231	Langfort	11	Liu Yue	219
Kranz	83	Lanzetta	41	Löberbauer	218
Kraxner	83, 448	Lappalainen	452	Lohrer	124, 128, 148, 223, 224
Krekoukia	276	Laqué	100	Loland N	15
Kretschmann	220, 435, 474	Larndorfer	358	Loland S	141, 385
Kretzschmar	224	Larsson B	28	Löllgen	351
Kristensen	379	Larsson H	164	Lopes	55, 104
Krogsgaard	39	Larue	128	Lorenz	243, 338
Królikowska	176, 269	Laskiene	419	Lormes	219, 309
Kröll	211	László	273	Lottermann	69
Krstic	106	Lattier	155, 156, 175	Lötzerich	36, 93, 105, 404
		Latvala	441	Lovecchio	472
				Luciana	293

## List of Authors

Ludwig	400	Martín	226	Michailidis	348
Luka	230	Martin A	155, 175, 243, 368, 381	Michna	36, 93, 105, 404
Lukac	106, 248, 249, 252, 476	Martin B	23, 24, 110, 152	Mickevičienė	80
Lullic	100	Martin D	362	Miclescu	288, 470
Lundbye	182	Martin V	155, 175	Miha	236
Lundvall	271	Martin-Diener	110	Mikalauskaite	105
Luukka	272	Martinmäki	251	Mikelkeviciute	397
Lyons	278	Martinov	261, 475	Mikkelsen	73
<b>M</b>		Martins M	82	Mikkelsen	162
Ma	162	Martins R	264, 469	Mikkola	291
Maassen	96, 359, 451	Martins Z	120	Mikulski	36, 377
Macaluso	44, 76, 77	Maruno	12	Milanovic	59, 227
Macedo	429	Marvi	136	Milic	49, 254
Machado Ma	267	Marzorati	80	Miller Be	158
Machado Mi	426	Masahiro	273	Miller BI	311
Machanek	113	Mashimo	12	Millet Gr	381
Machida	12	Massarelli	25	Millet Gu	90, 155, 156, 175, 337, 381
Macias	190	Massart	60	Mills	444
MacIntyre	51	Mastroandrea	419	Mimura	263
Madella	385	Masuda	256	Minetti	175
Mader	202	Matijevic	227	Minganti	120, 168, 234
Mäder	23	Matsakas	207, 360, 455	Miotti	260, 475
Madon	74	Matsuda	397, 402	Mirshafiee	185
Madsen Jø	178	Matsudo S	104, 268, 447	Mischler	85
Madsen M	19	Matsudo V	104, 268, 447	Mishchenko	62, 379
Madsen T	434	Matsui	273, 397, 402	Misigoj-Durakovic	416
Maemura	252	Matsumoto	248	Missitzi	59, 330
Maestá	461	Matsunaga	263	Mita	116, 121, 288, 452, 470
Mäestu	94	Mattei	432	Mittendorfer	158
Maffiuletti	175, 368, 381	Mattes	27	Mitterbauer	241, 437
Magalhães	55	Matton	214	Miyachi	75
Maganaris	44, 204	Maughan	184, 344	Miyamoto	101
Magini	293	Maurer	437	Miyamura	439
Magnusson	18, 154, 222, 390, 434	Mavrek	285	Miyanaga	266
Magyar	346	Maxwell	259	Miyazaki	134, 299
Mahseridjian	67	Mayer F	129, 302, 385	Mizuno	205
Maia	104, 238	Mayer J	216	Młynardzyk	36
Maier B	213	Mazur	459	Moas	186
Maier R	83	Mazzà	20	Modestini	428
Majoross	115	Mbalilaki	355	Moe	286
Makara	318	McKune	29, 52, 107, 376	Mohebbi	94, 438
Mäkikallio	369	McLean B	362	Molár	118
Malatesta	435	McLean S	160	Mölsä	402
Malina	60, 228	McNamee	286, 385	Mondrzyk	434
Malinauskiene	111	Mechling	196	Monna	439
Malkin	254, 406	Meckbach	271	Montaurier	85
Malzer	14, 266, 441	Meckel	252	Monteil	25
Mamdouh	392	Meeusen	168, 200, 219, 234, 241, 436	Monteiro	55
Mamen	240	Mehdi	236	Monteyne	457
Mamkus	80	Meijel	117	Montiel	100
Manca	472	Meléndez	313	Moons	449
Mançcan	239	Mello	101, 117, 442	Moore	263
Mancini	76, 233	Melo F	278	Mooren	35, 140
Manders	246	Melo J	267, 460, 461	Morad	19
Manger	110	Memari	185	Moraes	137, 267, 460, 461
Mann	29	Mendes	278	Morey Klapsing	48, 154
Manore	183	Mendez-Villanueva	249, 433	Moriconi	365
Manta	70, 242	Menz	113	Moriguchi	183
Manthou	249	Menzel	336	Morimoto	245
Mänttari	74, 272	Merikanto	19	Morin	47, 48, 155
Mantzouranis	98	Merlo	253	Mørkrid	391
Marchart	161, 262, 434	Mero	199	Morlock	266, 357
Marchewka	421	Merson	455	Moro	260, 475
Marchi	80	Mesquita	429, 430	Morozov	208
Marek-Engelke	50	Mester	70, 107, 122, 129, 149, 154, 165, 180, 199, 231, 344, 377, 378	Morres	115
Marija	236	Metcalf	114	Morris	162
Marino F	125, 205, 304	Metsios	177	Morse	367
Marino M	428	Metzger	96	Mortensen	347
Marinovic	121, 466	Meyer H	183	Morthorst	28
Marinovic-Terzic	260, 406	Meyer M	96	Mössenböck	212
Marques-Bruna	295	Meyer T	371	Mota J	106
Marshal	208	Mezey	68	Mota M	80, 456
Marstrand	182	Miah	331	Motobe	183
Marti	23, 24, 152, 375			Mougios	390, 455
				Mounier	57, 85, 459

Mourão-Carvalho .. 106, 275, 442  
 Moussay .....128  
 Mroz .....229  
 Muhin .....412  
 Mukai .....12  
 Müller E .... 14, 63, 157, 167, 172,  
 194, 211, 218, 266, 293, 294,  
 323, 336, 345, 365, 410, 441  
 Müller S .....129, 302  
 Munivvana .....58  
 Munzert .....197  
 Murase .....73, 183  
 Muro ..... 98, 101, 240, 256  
 Murray .....93  
 Musch .....49  
 Musil ..... 396, 403, 411  
 Mussgay .....19  
 Mustalampi .....18, 397, 471  
 Musulin .....279, 432  
 Mutrie .....51, 145  
 Mutter .....49  
 Mür .....164  
 Myers .....395  
 Myllynen .....402

## N

Nachbauer .....139  
 Nagasawa .....73, 183  
 Nagase .....256  
 Nagata .....131, 250  
 Nagatomi .....13, 34  
 Nagelkerke .....277  
 Nakagawa .....183  
 Nakaji .....12  
 Nakajima S .....89  
 Nakajima Y .....66  
 Nakamura .....37, 62  
 Nakanishi . 75, 247, 397, 402, 409  
 Nakano .....89  
 Nakao .....452  
 Nakas .....257  
 Nakic .....230  
 Nakou .....448  
 Nanyan .....37  
 Narici ..... 44, 175, 204, 367  
 Nascimento .....458  
 Nassis .....276  
 Natsui .....95  
 Naumovic ..... 106, 248, 256  
 Nazar .....36, 377  
 Neise .....351  
 Nemec .....295  
 Németh .....419  
 Némethné .....422  
 Nenonen .....446  
 Neumayr .....264, 437  
 Neuparth .....456  
 Neveling .... 29, 52, 107, 297, 376  
 Nevill ..... 102, 123, 278, 432, 475  
 Newton .....13  
 Nicholas .....459  
 Nicol .....84, 223  
 Nicolaysen .....300  
 Nielsen J .....182  
 Nielsen O .....33, 70, 360  
 Nieman .....195  
 Niemeier .....105  
 Niess .....321  
 Niessen M .....97, 304, 374  
 Niessen W .....323  
 Nieuwenhuis .....109  
 Niewiadomski .....377  
 Nigg ..... 153, 154, 306  
 Nigorikawa .....66  
 Nikbin .....185  
 Nikolaidis D .....467

Nikolaidis M .....455  
 Nikolau .....448  
 Nishimura K ....75, 247, 397, 402,  
 409  
 Nishimura M .....75, 81, 397, 402,  
 403, 411  
 Nissilä .....369  
 Noakes .....77, 314, 395  
 Nogueira .....80  
 Nomura .....179  
 Nørregaard .....39  
 Norris .....379  
 Nosaka .....13, 93  
 Nose .....75, 81, 397, 402  
 Noutsos .....274, 465  
 Noventa .....253  
 Nowak A .....378  
 Nowak Z .....477  
 Nummela .....291  
 Nuno .....462  
 Nunomura .....102, 283, 284  
 Nupponen .....162  
 Nurmekivi .....415  
 Nuutila .....79

## O

Oakley .....259  
 Obad .....260, 406  
 Obara .....439  
 Occhipinti .....41  
 Ochala .....125  
 Odabas .....243  
 Ogawa .....82  
 Ogiso .....327  
 Ogita A .....263  
 Ogita F .....139, 262  
 Ogonovszky .....318  
 Ohbayashi .....81  
 Ohkuwa .....439  
 Ohno H .....102  
 Ohno M .....89  
 Ohshima .....95  
 Ohtsuka .....81  
 Ohtsuka .....411  
 Oikonomidis .....424  
 Oishi .....66  
 Oja L .....427  
 Oja P .....24, 46  
 Ojuka .....31  
 Oka J .....82  
 Oka K .....98, 101  
 Okano A .....267, 460, 461  
 Okano R .....267, 460  
 O'Keeffe .....280  
 Oksa .....348  
 Oksala .....452  
 Olbrecht .....203  
 Olesen .....154, 204, 206, 390  
 Oliveira C .....271  
 Oliveira F .....103, 263  
 Oliveira L .....268, 447  
 Oliveira R .....42  
 Olivieri .....281  
 Olm .....244  
 Olsen D .....247  
 Olsen S .....50, 206  
 Omar .....209  
 Oncken .....239  
 O'Neil .....278  
 Ono .....34  
 Onodera ....75, 81, 247, 273, 403,  
 409, 411  
 Orizio .....32  
 Ørskov .....28  
 Ortanescu C .....282, 424  
 Ortanescu D .....282, 424, 437

Ortolano .....249, 433  
 Osada .....73, 183  
 Osgnach .....251  
 Osinski .....443  
 Ostaseviciene .....425  
 Osterburg .....70, 107, 149, 231  
 Östlund .....291  
 Ostrowska .....400, 401  
 Otáhal .....399  
 Öttl .....83, 376  
 Otto .....402  
 Overgaard .....33, 71  
 Owen .....9, 47  
 Owusu-Ansah .....474  
 Ozbek .....99  
 Ozer .....243  
 Ozsvath .....420

## P

Paavolainen .....291  
 Pabst .....136  
 Pacheco .....313  
 Pacher .....400  
 Paci .....279, 432  
 Padlina .....152  
 Pagonis .....104  
 Pais .....91  
 Pakarinen .....55, 199, 354, 375  
 Pálfi .....225  
 Pampín .....226  
 Pananakakis .....448  
 Panayiotou .....98  
 Pannier .....331  
 Papadopoulos .....230, 467  
 Papandreou .....97  
 Papic .....123  
 Papp 65, 413, 415, 417, 430, 466,  
 472, 473  
 Parisi .....320, 321, 453  
 Parkkari .....74, 272  
 Parmenter .....257  
 Parravicini .....41  
 Paschalis .....249, 390  
 Patikas .....348  
 Patrone .....76, 233  
 Patterson .....139, 211  
 Paulogiannis .....294  
 Paulsen .....390, 391  
 Paulweber .....157  
 Pausic .....58, 221  
 Pavan .....253  
 Pavicic .....343  
 Pavlenko .....58  
 Pavlovic .....405  
 Payerl .....83, 376  
 Payton .....126  
 Pedersen .....70  
 Pedrosa .....263  
 Pehlivan .....243  
 Pelikan .....396, 403, 411  
 Pellegrini .....300  
 Pellegrino .....260, 475  
 Pellizzari .....333  
 Penas .....226  
 Pequignot .....85  
 Perc .....329  
 Pereira .....355  
 Pérez .....190  
 Perez-Landaluce .....249, 433  
 Perim .....64  
 Perini .....237  
 Perl .....342  
 Perrey .....245  
 Pers .....466  
 Persyn .....330  
 Perttunen .....19

Peters C	36, 93, 105	Prusakova	89	Rocha S	67
Peters E	52	Pruscino	184	Rocha-Ferreira	188
Petike	478	Prusik	234, 464, 465	Röder	128, 148
Petit	96	Psarra	276	Rödler	400
Petkovic	56, 228	Pshendin	89	Rodrigues	288
Petriaev	131	Pühringer	211, 250	Roeleveld	57
Petrin	261, 475, 476	Pühse	162, 426	Rogaleva	254, 431
Petro	473	Pulkkinen	251	Rogozkin	86, 187, 453, 454
Petrov	453	Pullinen	199	Rogulj	123
Pfeifer	356, 440	Puolakka	247	Rohlmann	357
Pfeiffer Mark	334	Puranen	247	Rohrer	400
Pfeiffer Mart	104	Purvis	244	Roi	251
Pfister	262, 264, 437	Puteh	167	Rojas	149, 199
Philadelphia	139	Pyne	196	Roman	284
Philippaerts	54, 214	<b>Q</b>		Ronchi	472
Piacentini	150, 168, 234	Queirós	423, 470	Ronsen	195, 337
Pialoux	57, 85, 459	Quittan	400	Rooney	78
Piasecki	64	<b>R</b>		Rosado A	285
Piechura	400	Raas	264	Rosado F	260
Piel	83	Raastad	390, 391	Rosenbaum	295
Pienaar	356	Rác	297, 301, 327	Ross	386
Pienimäki	40, 441	Raczak	300, 410	Rossignol	57
Pieper	59	Radak	318	Rost	339
Pierucci	458	Radosavljevic	405	Rosted	18
Pietarila	352	Rahimi	450	Roth	70, 107, 129, 231
Pietraszewski	307	Rahmani-Nia	94	Rotstein	252
Pihl	415	Rajtmajer	416	Rousanoglou	126, 465
Pilegaard	208	Rakovac	90	Rowland	392
Pimenta	448	Ram	392	Roy JP	388
Pinaev	208	Rama	82	Roy S	452
Pinto	426, 428	Ramezani	406	Rozek-Mróz	400, 401
Pire	274	Ramon	461	Rozitis	303
Pisot	329, 464, 468	Rampinini	240, 318	Rozman	329
Pittaluga	320, 453	Rance	271	Rud	33, 360, 394
Pizzini	61, 282	Randakova	290	Rudack	35, 140
Place	90	Rao	61	Rüddel	19
Platanou	60	Rapp	224	Ruell	86, 87
Platen	50, 65, 92, 113, 150, 220, 318, 374, 435, 474	Raschner	211	Rugási	68
Plavina	450	Ratkevicius	200	Ruhleder	398
Plested	168	Ratkowski	300, 410	Rupp	396, 411
Plewa	229, 409, 474, 477	Ravagnani	461	Rusko	51, 247, 251, 291
Ploug	11	Rayssiguier	459	Russell	395
Pochon	56	Recht	306	Rusu	372, 405, 424, 437
Poderys	82	Reer	313	Rutkowska-Kucharska	133
Poenaru	372, 405	Rees	38	Ruzic	416
Pogliaghi	16, 85	Reeves	44, 204	<b>S</b>	
Poissonnier	96	Regueme	84	Sääkslahti	163
Pokan	84, 313, 400, 411, 448	Reilly	330, 362	Saalasti	251
Polzovic	268, 269	Reiser	197	Saar	232
Ponchia	374	Reisner	166	Sabatini A	293, 419, 428
Pontaga	299, 347, 475	Reissnecker	187	Sabatini S	87, 320, 453
Popov	84	Reiterer	376	Saboisky	205
Popovic D	118	Remes	441	Sacchetti	247
Popovic R	64, 282	Remmen	240	Sacco	13, 93
Porfilho	287	Renger	293	Sachinwalla	78
Porozovs	428	Renneberg	86	Sadamoto	245
Porta	377	Rennie	159	Sadegh	236
Potthast	365	Renson	188	Sæterbakken	110
Pouilly	56, 255	Rétsági	273, 420, 423, 477, 478	Saginoya	34
Pousson	125	Rhodius	66	Saitoh	12
Povalyashko	258	Ribeiro B	458	Sakamoto	421
Pozzo	365	Ribeiro S	460	Sako	183
Praprotnik	329	Ricardo	412	Sakss	347
Praulite	428	Ricketson	362	Sallinen	55, 268
Predel	14, 100, 220, 435, 474	Riek	125, 181, 205	Salonen	291
Préfaut	245, 435	Rinderu	124	Saltevo	247
Preli	67	Ring	14, 63, 127, 157, 266, 441	Saltin	138, 247, 381
Preuss	36	Ritzke	359	Salzburger	241
Priamo	253	Rivas	226	Samborsky	84
Pries	359	Rivera	297	Samsoniene	20
Prioux	382	Robazza	116, 216	Samulski	109
Prisztóka	65, 413, 415, 417, 430, 466, 472, 473	Roberts G	311, 333	Sánchez	419, 428
Prokop	213	Roberts K	393	Sande	240
Prot	310, 311	Roberts R	108	Sanders	310
		Rocha D	137	Sándor	130

Sanka	12	Schwartz	298, 345	Skorocká	292
Santana	117	Scott	295	Skoufas	348
Sántics	66	Secher	33, 360, 394	Skurvydas	80, 200
Santini	135	Segesser	148	Slaba	290, 292
Santos A	60, 79, 260	Segieth	402	Slørdahl	354
Santos Ca	91	Seifert	250, 451	Smekal	84, 191, 400
Santos Cl	267, 460, 461	Seifríz	129, 344	Smerecnik	139
Santos Pa	238, 412	Seki	101	Smerilli	428
Santos Pe	270, 296, 367	Sekir	404	Smilios	98, 160, 438
Santos R	101, 117	Selänne	18, 132, 397, 471	Smith Al	112, 193
Santos S	127	Semen	353	Smith An	46
Santos T	34	Semple	29, 52, 107, 376	Smith D	379
Santos-Rocha	232	Sen	452	Smith G	194
Sarabon	49, 176	Sengoku	179	Smith L	29, 52, 107, 376
Sardinha	264	Senner	366	Smorawinski	36, 377
Sarmiento	75	Sensui	34	Smulskij	88
Sarrafnjad	185	Seppänen	352	Smyth	280
Sarre	26	Serafin	133	Sneiders	450
Sarto	253	Serbetar	429	Sniras	111
Sarudate	444	Serdar	89	Snook	314
Sasaki	67	Serhiyenko	353	Snyder	257
Sasse	369	Sertbas	99	Soares E	458
Sassi	240, 318	Sesboué	128	Soares J	106
Sasvari	318	Sforza	302, 472	Sobral	60, 469
Satkunskiene	126	Shadrina	58	Södergård	19
Sato	12, 444	Shahram	407	Soehngen	440
Sattlecker	293	Sharei	450	Soldá	87
Saunders	61	Sharifmoradi	236	Sólyom	130
Sauseng	376	Shaw	183	Sommer	36
Savelev	84	Sheridan	142, 286	Soot	275
Savini	87, 320, 453	Shibusawa	12	Söser	191
Saxkjær	222	Shidlovskaya	272	Sotiropoulos	160, 438
Scaglioni	175	Shidlovsky	272, 440	Sousa	127, 456
Scarpa	476	Shima	131	Spamer E	109
Schaar	156, 157	Shimaoka	439	Spamer M	67, 179, 222, 389
Schack	150, 197, 198	Shimoda	439	Spangenburg	186
Schäfer	207	Shimoyama	179	Spencer	206
Schantz	291	Shin	265	Sperlich	69
Schaper	304	Shindler	279	Spiesberger	396, 403, 411
Schega	27, 136, 370	Shinoda	54	Spiewak	379
Schena	16, 85, 281, 300	Shirai	135, 302	Spinella	87
Scherney	213	Shiraki	179	Spinelli	310
Scheffelen	40	Shirasaki	12	Spitzenpfeil	231, 243, 338
Schiavinato	374	Shirreffs	184, 455	Spriet	11
Schiefermüller	211, 323	Shkolnikova	414	Springrova	399
Schieppati	23	Shonina	208	Srdic B	252, 268, 269, 270
Schilcher	127	Shuichi	186	Srdic S	265
Schimanski	290	Shushakov	96, 359	Sreenivasan	395
Schindler	122	Sialis	392	Srroj	123
Schirnhofner	157	Sidossis	276	St Clair	395
Schmid A	63, 319, 380	Sieminski	307	St Clair Gibson	77
Schmid P	400	Sifta	305	Stadlmann	63
Schmidt F	19	Siira	40	Stafilidis	48, 154
Schmidt W	173	Sikora	400	Stallknecht	386
Schmidtbleicher	197, 228, 306, 378, 384	Sillero	442	Stallman	134, 387
Schmidt-Trucksäss	90, 327	Silva A	80, 106, 275, 442, 456	Stamm	238
Schneider E	357	Silva L	271	Stanganelli L	64, 239
Schneider G	451	Silva M	448	Stanganelli P	283, 289
Schneider M	50	Silva P	470	Stankovic	118
Schneider S	113	Silva R	460	Stapelfeldt	57, 63, 319
Schobersberger	378	Silvennoinen	207, 454	Starczewska-Czapowska	79
Schöllhorn	91, 170, 304, 370	Simar	435	Starischka	319
Schönung	151	Simmer	378	Stark	197
Schorer	54	Simões	461	Stasiulis	95, 200
Schüle	19	Simon	396	Steensberg	77, 208
Schulz H	374	Simpson	61	Stefanyshyn	321, 388
Schulz T	36, 93, 105, 360, 404, 455	Simunic	329	Steinacker	187, 219, 309
Schulze	147	Singer	173	Stella	442
Schumacher	57, 63, 90, 319, 327	Sinitsin	131	Stemplewski	443
Schwabberger	313	Sipos	109	Stilec	15
Schwameder	127, 194, 323, 344, 365	Sjöström	24	Stilgenbauer	309
Schwellnus	314	Skarbalius	335	Stirling	381, 389
Schwerdfeger	370	Skenderi	276	Stocchi	76, 233, 407
		Skille	167	Stöggli	336
		Skipka	376	Stoia-Djeska	99
		Skopetz	396, 403, 411	Stokic	256, 268, 269

Stone	37, 62
Strass	174
Straube	278
Stray-Gundersen	333
Street	250
Strojniak	49, 223, 405
Strømme	355
Strubreither	189
Strüder	93, 149, 150, 199
Strumbelj	257
Sturm	237
Subudhi	178, 183
Sudi	83, 376
Sudo	437
Sue	78
Suetta	18, 178, 206, 390
Sugawara	12
Sugi	397, 402
Sugiura	102
Suh	158
Sukhov	190, 426
Sulzer	314
Sum	119
Supaj	295
Suriano	52, 100, 319
Sürmen-Gur	89
Sussova	305
Sust	153, 303, 387
Suzuki K	12
Suzuki T	102
Suzuki Y	252
Svedenhag	33
Sveinsson	314, 470
Svistelnyk	287
Sygusch	151, 166
Szatmári	413, 415, 417, 430, 466, 472
Szczesna-Kaczmarek	75
Szegner	277
Szeklicki	443
Szilágyi	130
Szmatlan-Gabrys	229, 409, 474, 477
Szucs	66
Szwoch	410

## T

Tabatabaei	100
Tadano	101
Taeymans	92
Taillardat	96
Tajima	131, 250
Takahashi H	444
Takahashi K	75, 397, 402, 411
Takahashi N	266
Takala	186
Takamatsu	54, 252
Takayanagi	98
Takayuki	272
Takekura	262
Takemasa	102
Takito	103, 371, 460
Taks	214
Talaban	452, 470
Tam	237
Tamaki	139, 262
Tamas	353
Tammelin	441
Tan H	200
Tan L	28
Tanabe	256
Tanaka	124, 134, 299
Tang	86
Taniguchi	279
Tapio	353
Tardieu	382

Tarnita D	136, 307, 476
Tarnita R	136
Tarpenning	125, 304, 368
Tarvainen	148
Tashiro	34
Taskiran	99
Taube	124
Tavares	260, 394
Taylor	21
Téczy	225, 434
Teixeira A	82
Teixeira L	102
Teixeira O	461
Telonio	47, 155
Teräs	71
Terrados	249, 433
Terziotti	16, 85
Terzis	70, 242
Tesch	210
Tessitore	241, 281
Thaller D	434
Thaller S	153, 303, 387
Thauer	59
Theeboom	146
Theocharis	249
Thevenet	382
Thiele	156
Thom	367
Thomas C	289
Thomas E	77
Thomas V	56, 255
Thompson	86, 87, 244, 254, 368, 401
Thomson	117, 244
Thomson	78
Thorlindsson	470
Thornell	246
Thorwesten	35, 140
Thuring	110
Thune	364
Tiberi	281
Tihanyi J	297, 301, 327, 435
Tihanyi T	278
Tihanyiné	435
Tikkanen	247
Tilp	153, 303, 387
Timo	353
Tipton	324
Tirapegui	460
Tironi	237
Titze	46
Tofas	249
Toivanen	73
Tokarski	474
Tokmakidis	98, 160, 438
Tokuyama	12
Toledo	460
Tolnai	434
Tomás	91
Tomasevic	106, 252, 256
Tomazin	133, 223
Tomiak	62, 379
Tooke	459
Tordi	419
Török	66
Torrents	171
Torstila	402
Tosi	300
Toskic	118
Toth	65
Totsuka	12
Toufras	454
Toyoda	306
Traistaru	372, 405, 437
Treasure	333
Trenell	78

Tricoli	239
Tritschoks	69
Trinic	479
Tsaopoulos	135, 424
Tseng	200
Tsigilis	448
Tsikrikis	104
Tsimeas	424
Tsiokanos	135, 424
Tsiokos	17, 281
Tsiotra	249
Tsuboyama	444
Tsukamoto	284
Tsunoda	124, 134, 248, 299, 437
Tsutomu	272, 440
Tufekovic	50, 206
Tufik	92, 442
Tulppo	253, 291, 352, 353, 369
Tunstall H	244
Tunstall R	159
Turci	135, 302, 472
Turunen	272
Tusch	345
Tusker	298
Tutz	306

## U

Ueda	73, 183
Ugelstad	391
Uhlenbruck	404
Ulaga	223
Ulrich	404
Umbrasko	450
Unierzyski	338, 441
Uoran	75, 397, 402
Urhausen	371
Usaj	257, 411, 469
Uusitalo-Koskinen	51

## V

Vaczi	301
Vaeyens	54
Vaitl	197
Valamatos	296, 367
Valdemiers	428
Valencic	161, 329
Valic	260, 406
Välipakka	19
Valkeinen	354
Vallejo	168
Valquer	67
Valuziene	397
Van Coppenolle	144, 214
Van de Vliet	144
Van den Bogert	160
Van den Tillaar	110, 379
Van der Beek	355
Van der Woude	380
Van Hall	247
Van Hoecke	90, 125, 175
Van Langendonck	449
Van Leemputte	362
Van Loon	10, 246
Van Mechelen	151, 355
Van Niekerk	77
Van Overschelde	49
Van Peteghem	214
Van Poppel	151
Van Praagh	271
Van Rossum	109
Van Roy	42, 127, 366
Van Sluijs	151
Van Vaerenbergh	413
Van Wichelen	123
Vandaele	413
Vandenabeele	269
Vandewiele	449

Vanharanta	40
VanHoecke	26
Vanicek	296
Vanreusel	16
Vareltzis	465
Varga	110, 280, 371
Varstala	163
Vasic	252
Vasques	104
Vass M	65, 413, 415, 417, 430, 466, 472, 473
Vass Z	110, 280, 371
Vassiliadou	70, 242
Vaughan	395
Vaz A	168
Vaz V	60
Vázquez	75
Veeger	380
Vehovar	416
Velázquez	294
Veloso	232, 296, 367
Vences	440
Venditti	428
Ventura	212
Vercruyssen	52, 100
Verdoia	41
Vereijken	171
Verhagen	355
Verlinden	123, 366
Vermorel	85, 96
Vicente-Rodríguez	408, 436
Vieira	271
Vigário	103, 263
Vihko	73, 207, 454
Viitasalo	194
Vilar	442
Vilas-Boas	127, 456
Vilela Barros	141
Villanella	419
Villani	67, 232, 233
Vingren	37, 62
Vinogradov	62
Virmavirta	365
Virtapohja	19
Visscher	143, 161, 226
Vitt	157
Vleck	340
Vodicka	62, 246
Vogel	140
Vogt A	407
Vogt L	398
Vogt M	210
Voicu	284
Volbekiene	447, 471
Volek	55
Völker	35, 140
Volkov	84
Volkwein-Caplan	213
Volossovitch	335
Von der Grün	229
Von Duvillard	84, 313, 400, 448
Von Tschärner	172
Vonbank	434
Vonsovskiy	258
Vrabas	467
Vucetic	56, 228
Vuckovic	290, 292, 466, 479
Vujin	265
Vukovic	260, 406
Vuleta	59, 227

<b>W</b>	
Wadazumi	263
Wadee	29, 376
Wagatsuma	139, 262
Wagenmakers	10, 246
Wagner Hei	171
Wagner Her	172, 410
Wagner Pete	140
Wagner Petr	151, 173
Wakeling	154, 216, 303, 306
Walker	183
Wallis	458
Walseth Ka	147
Walseth Ki	146
Walsh	263
Walter	197
Walvoort	366
Wang E	354
Wang G	355
Wang L	219
Ward	341
Watanabe H	263
Watanabe K	263
Watanabe M	179
Watson	184
Watt	11
Watzinger	83
Weber K	59, 69
Weber S	65, 318
Wehrlin	375
Weigand	114, 115
Weiss Mar	157
Weiss Mau	192
Weißbach	451
Wenk	104
Werner	37, 114
Wertheim	425
West	77
Westra	87
Whipp	341
White	368
Wiborg Lange	28
Wigger	165
Wijndaele	214
Wijns	214
Wilerson	383
Wiley	306
Wilhelm	66, 273, 414, 478
Williams C	459
Williams J	289
Williams M	184
Wilmshurst	383
Wimmer	357
Winsley	179
Winter	382
Winther	39
Wirth	378
Wiswell	368
Witt	339
Witte	130, 136, 302
Wohl	43
Wolf	231
Wolfarth	185
Wolter	36
Wong	162
Wonisch	83, 84, 313, 400, 448
Woodfield	102, 278, 432, 475
Woods	364
Wooram	411
Wouters	113
Wu	459

Wurm	369
Wyatt	301
Wylleman	191
<b>X</b>	
Xiotis	97
Xuan	12
<b>Y</b>	
Yamagata	101
Yamaguchi H	75, 81, 247, 397, 402, 409, 411
Yamaguchi K	13, 34
Yamakawa	82
Yamamoto	139
Yamazaki K	75, 411
Yamazaki Y	439
Yanagi	95
Yanagisawa	266
Yap	315
Yasukawa	66
Yau	86
Yazdani	235
Yelisyeyeva	258, 353
Yfanti	249
Ylinen	148
Yngve	24
Yona	101, 240, 256
Yoon	364
Yoshioka A	75
Yoshioka H	266
Younesian	88
Young	61
Yu	246
Yuan	86
Yue	378
Yusoff	450
<b>Z</b>	
Zago	137
Zahalka	305
Zakynthinaki	381, 389
Zallinger	218
Zamai	476
Zameziati	47, 155
Zander	360
Zanevskyy	287
Zapartidis	346, 465
Zapata	168
Zatloukalová	399
Zavrsnik	329, 468
Zebis	347
Zelli	120
Zentgraf	197
Zerjal	329
Zernicke	43
Zerva	276
Zhang	191, 334
Zickermann	59
Zidens	299, 347, 475
Ziegler	377
Ziemann	75
Ziembra	36
Zifko	396, 403, 411
Zimmermann	24
Zimmermann-Sloutskis	24
Zordanazzo	253
Zorenc	246
Zouhal	382
Zrinko	230
Zucas	239
Zuest	375
Zurc	464, 468
Zvzdic	257



## Keywords

- 2**  
2008 Olympics .....294  
200m medley .....56  
2km walk test .....266
- 3**  
3D analysis .....61, 305, 365  
3D kinematics .....344, 367  
3D topographical analysis .....70
- 4**  
400m hurdles .....367
- 8**  
8-hydroxy-deoxyguanosine .....89
- A**  
abrasion .....130  
academic degrees .....413  
acceleration .....305  
accelerometer .....273  
accident .....265  
accidental falls .....170  
accuracy .....110, 129  
ACE gene .....454  
achievement goals .....333  
achilles tendon .....128, 148, 154  
Achilles tendon rupture .....270  
acid-base equilibrium .....452  
acidosis .....75, 359  
ACL .....40, 97, 205, 266, 404, 408  
acromio-clavicular joint .....127, 307  
activation level .....347  
active leg stiffness .....329  
active lifestyle .....215  
activity .....46, 357  
acupuncture points .....399  
acute phase response .....376  
adaptation .....64, 66, 82, 180, 415, 417  
adapted physical activity .....212, 213, 214, 350, 425  
adipose tissue .....208  
adipose tissue metabolism .....386  
ADL-monitoring .....295  
adolescent females .....109  
adolescent swimmers .....234, 267  
adolescents .....104, 238, 282, 289, 438, 442, 476  
adult education .....430  
aerobic capability .....353  
aerobic capacity .....54, 79, 95, 227, 240, 271  
aerobic dance .....413, 435  
aerobic endurance .....467  
aerobic endurance exercises .....19  
aerobic exercise .....249, 438, 461  
aerobic fitness .....60, 72, 234, 249, 266, 276, 383  
aerobic performance .....243, 384  
aerobic power .....78, 131, 209, 264  
aerobic training .....291, 448  
aerobics .....95, 440  
aesthetics .....142, 283  
aerference .....22  
age .....117, 162, 169, 200, 348  
age difference .....288, 470  
agility .....114  
aging .....25, 55, 76, 80, 106, 125, 169, 174, 175, 179, 204, 271, 304, 320, 321, 329, 364, 367, 368, 435  
air pistol .....300  
alcohol abuse .....212  
all-out run .....155  
alpine ski racers .....211  
alpine skiing .....129, 210, 211, 231, 250, 251, 264, 323, 366  
altitude .....35, 247, 374  
altitude training .....375  
ambulance calls .....265  
amino acid .....52  
ammonia .....254, 451  
AMPK .....31  
amplified knowledge of results .....278  
anabolic agent .....28  
anabolism .....324  
anaerobic .....79, 246  
anaerobic abilities .....243  
anaerobic capacity .....229, 249, 292, 379, 409, 474, 477  
anaerobic fitness .....60  
anaerobic performance .....460  
anaerobic power .....240, 408, 409, 412  
anaerobic threshold .....177, 252, 313, 448  
anaerobic threshold modelling .....318  
anaerobic working capacity .....56, 255  
analysis of motion .....301  
Ancient Olympics .....387  
angiotensinogen gene (AGT) .....453  
ankle .....222  
ankle injury .....355  
ankle sprain .....224  
anthropometric data .....99, 179, 271  
anthropometry .....56, 92, 274, 290, 345, 442, 465, 473  
anticipation .....244  
antioxidants .....89, 320, 321  
antioxidative capacity .....256, 459  
anxiety .....109, 111, 116, 120  
apnea .....139  
apoptosis .....28  
applied science .....215  
applied sport psychology .....215  
aquatic therapy .....397, 402  
arm crank .....88, 403  
arm exercise .....72  
arm movement .....278  
arm paddling .....433  
arthrokinematics .....42, 127, 366  
arthroplasty .....44, 358  
Asberger's syndrome .....446  
assembling .....280  
assessment .....24  
astaxanthin .....250  
asthma .....374  
Astrand Step Test .....450  
asymmetry .....221  
athletes .....111, 326, 375, 414, 452  
athletic development .....309  
athletic heart .....265  
athletics .....135, 468  
attention .....124  
attitude .....418, 419, 427, 428, 430, 432  
attitude assessment .....417  
attitude change .....466  
audio-visual information .....196  
autistic children .....397, 402  
autologous chondrocyte transplantation .....405  
autonomic cardiovascular control .....90, 369  
autonomic nervous system .....19, 237, 410, 411
- B**  
backswing .....126  
badminton .....120, 457  
balance .....222, 404  
balance board .....355  
balance capabilities .....268  
balance control .....435  
balance of training .....226  
ball velocity .....129, 299  
ballet .....269, 473  
baroreflex sensitivity .....410  
barriers to sport .....282  
Barthel index .....20  
baseball .....134, 299  
basic motor abilities .....37  
basic training .....339  
basketball .....113, 120, 190, 225, 230, 241, 290, 292, 312, 335, 412, 426, 467, 479  
BCAA .....184  
beach-volleyball .....190  
bed rest .....36  
beginner .....425  
behavior .....288, 424, 430  
behavior pattern .....66  
behavioral control .....424  
behavioral epidemiology .....9  
behavioral pattern .....446  
behavioral profile .....285  
beta blocker .....408, 448  
beta1-blockade .....313  
bicarbonate buffering system .....252  
bilateral deficit .....279  
binomial logistic regression .....335  
biochemistry .....453  
bioenergy .....35, 177  
bioimpedance .....292  
biomechanical tests .....194  
biomechanics .....25, 49, 193, 297, 322, 323, 336, 380, 467  
birth-date distribution .....54  
blended learning .....165  
blood .....97  
blood circulation .....378  
blood flow .....33, 71, 79, 360  
blood groups .....89  
blood lactate .....79, 250, 400, 472  
blood lipids .....276, 448  
blood oxygen .....437  
blood pressure .....51, 106, 245, 273, 326, 352, 397, 448  
blood rheology .....209  
blood status .....457  
blood viscosity .....101  
BMD .....12  
BMI .....76, 381  
board paddling exercise .....249  
body .....393, 423  
body building .....104, 475  
body composition .....96, 103, 248, 268, 269, 274, 290, 442, 449, 465, 470  
body equilibrium .....472  
body fat .....102, 268, 409, 473, 475  
body fat mass .....276  
body height .....75  
body image .....102, 213

- body scanning .....345  
body values .....470  
body vibrations .....378  
body weight .....75  
body weight unloading .....77  
Bologna process .....413, 414  
bone .....43, 159, 217  
bone mass .....436  
bone mineral density .....275  
botulinum .....305  
boxing .....67, 215, 241  
brain .....373, 384  
breast cancer .....404  
breath-holding .....139, 406  
bronchial asthma .....400  
Bruce test .....260  
buffer capacity .....72  
buoyancy .....134  
burnout .....333  
bursitis .....405  
butterfly stroke .....127
- C**  
Ca<sup>2+</sup> release .....87  
Ca<sup>2+</sup> uptake .....87  
cadence .....26  
caffeine .....260  
CAFT .....450  
calcium .....71, 73, 140  
CaMK .....31  
cancer .....364  
canoe slalom .....251  
canonical correlation analysis .....310  
capillary .....98  
captology .....114  
carbohydrate .....29, 315, 324, 325, 458  
carbohydrate electrolyte .....456  
carbohydrate ingestion .....451, 461  
carbohydrate metabolism .....209, 247  
cardiac autonomic activity .....398  
cardiac diseases .....351, 374  
cardiac structure and function .....258  
cardiac transplantation .....400  
cardiac vagal modulation .....273  
cardiorespiratory disease .....351  
cardiorespiratory fitness .....395  
cardiorespiratory responsibility .....62  
cardiovagal reactivation .....101  
cardiovascular .....313  
cardiovascular disease .....10, 463  
cardiovascular drift .....401  
cardiovascular exercise .....444  
cardiovascular function .....82  
cardiovascular mortality .....351  
cardiovascular prevention .....474  
cardiovascular risk .....100, 416  
cardiovascular risk factors .....94, 438  
case study .....35  
catecholamines .....85  
cellular damage .....453  
center of gravity .....136  
central activation .....90  
central and peripheral adaptations .....85  
central fatigue .....150, 176, 184, 205  
central motor function .....439  
central nervous system .....219  
cerebral oxygenation .....392  
cerebral palsy .....236  
cervical spine .....402  
changes .....146  
characteristics .....222  
CHD-risk factors .....157  
cheating .....311  
chemo therapy .....36  
chemoreceptors .....341  
Chen-Style Tai Chi Chuan .....35  
child development .....295  
childhood .....104, 445  
children .....66, 75, 76, 84, 106, 157, 199, 213, 220, 233, 241, 302, 376, 387, 424, 427, 429, 435, 460, 476  
chronic chagasic cardiopathy .....263  
chronic disease .....9, 157  
chronotype .....92  
circadian rhythm .....243, 411  
classification in swimming .....27  
clavicle .....476  
clinical depression .....115  
clinical trials .....145  
clinical work .....421  
clustering .....300  
CO<sub>2</sub> output .....252  
CO<sub>2</sub> stores .....341  
coach .....192, 285, 363  
coach profiles .....428  
coach-athlete relationship .....147  
coaching .....134, 283, 288, 393, 426, 430, 468  
co-education .....115  
cognition .....197, 198  
cognitive abilities .....118, 220  
cognitive function .....117  
cognitivism .....286  
collagen .....159, 434  
colon cancer .....105  
combat sport .....233  
commercialism .....180  
communal sports infrastructure .....281  
community .....46, 445  
community sport .....17  
competition .....63, 119, 120, 319, 424  
competition exercise .....120  
competitive anxiety .....331  
competitive settings .....429  
compound action potential .....359  
computer science .....190  
computer simulation .....191  
computer-based training .....122  
concentration .....114, 244  
concentric contraction .....33, 86  
concentric exercise .....262  
concepts .....426  
conceptual analysis .....286  
conditioning .....59  
conditioning status .....227  
conflicts in sport science .....188  
consultancy .....113  
contact sports .....116  
content structure .....141  
continuous exercise .....411  
contractile mechanism .....125  
contraction frequencies .....360  
contraction types .....304  
contraction velocity .....201  
control of performance .....241  
control of training .....190  
contusion .....95  
cooperativeness .....167  
coordination .....37, 57  
coordination dynamics .....170  
COPD .....374  
coronary risk factors .....355  
cortical thickness .....37  
corticospinal pathways .....181  
cortisol .....200, 270  
counselling .....152  
counter movement jump .....329  
C-peptide .....87  
creatine .....50, 93, 206  
creatine kinase .....13, 390  
creatine supplementation .....451, 460  
credits .....214  
critical moments .....335  
critical power .....37, 56, 62, 255  
critical velocity .....37, 62, 267  
crossbow .....116  
cross-country skiing .....70, 107, 229, 231, 290, 336, 337, 365  
CRP .....376  
CSA .....475  
cultural studies .....145  
culture .....287  
curriculum .....214, 220, 285, 413, 420, 423, 478  
curved walking .....23  
cycle ergometer .....307  
cyclic drive .....339  
cycling .....26, 57, 63, 65, 128, 137, 177, 178, 313, 319, 322, 325, 346, 361, 362, 366, 371, 456, 457, 461  
cycling cadence .....52  
cycloergometric methods .....474  
cytokines .....12, 77, 195  
cytoskeleton .....132
- D**  
daily living activities .....20  
damage .....262  
dance .....428  
data bank .....477  
data base .....113, 271  
defensive opponent .....160  
degenerative disease .....475  
dehydration .....314  
delayed onset muscle soreness .....390  
demography .....15  
dependent elderly .....273  
depression .....107, 111, 144, 442  
DeQuervain's disease .....34  
dermatoglyphics .....431  
developmental kinesiology .....311  
diabetes .....207, 454, 467  
diagnostics .....62, 330  
diary method .....469  
diet .....156, 462  
differential learning .....224  
disability sport .....350  
disability swimming .....126, 477  
disabled athletes .....458  
disadvantaged minorities .....477  
disassembling .....280  
discontinuity patterns .....144  
distance running .....374  
diving .....406, 469  
DNA .....318  
document analysis .....290  
doping .....282  
downhill running .....175  
downhill walking .....254  
drop jump .....200  
dropout .....340  
drosophila .....456  
dumbbell exercise .....439  
dynamic balance .....136, 235, 236, 307  
dynamic patterns .....172  
dynamic systems .....171  
dynamic training .....240  
dynamics .....126, 171, 388

dystrophin .....132

**E**

early identification .....416

eating disorders .....213

EBV .....196

eccentric contraction ..84, 86, 210, 254, 347, 358

eccentric exercise ....87, 210, 223, 246, 262, 390, 434

ECG .....83

echocardiography .....65

economy .....91, 165, 388

edema .....378

education ..38, 165, 294, 471, 477

educational interventions .....282

educational styles .....472

EEG .....395, 443

effect evaluation .....151

efficiency ...47, 58, 155, 297, 327, 387

elasticity .....315, 316

elbow .....366

elbow flexors .....13

elderly ..14, 15, 18, 44, 61, 82, 85, 90, 93, 101, 102, 104, 117, 173, 251, 268, 281, 439, 440, 443, 444, 445

e-learning 113, 122, 165, 166, 189

electrical stimulation .80, 125, 175

electrolytes .....359

electron spin resonance .....256

electronic rights .....165

elite athletes ...26, 113, 147, 192, 193, 195, 255, 337, 426, 464, 476

elite career .....340

elite sport .....180, 190, 191, 192, 193, 309, 343, 361

emergence .....343

EMG ...23, 39, 42, 44, 76, 77, 90, 96, 131, 137, 155, 178, 201, 256, 296, 302, 303, 306, 307, 345, 348, 368, 388, 402, 408, 410, 467

EMG activity .....175, 398

EMG power spectrum .....97

emotion .....116, 333, 338

empowerment .....402

endoprosthesis .....357

endurance ....234, 305, 440, 457, 465

endurance athletes .....258, 291

endurance diagnostics .....231

endurance exercise .63, 158, 195, 337, 410

endurance fitness .....314

endurance performance ..72, 185, 451

endurance sports .....107

endurance training ...69, 207, 291, 368, 371, 394, 454

energy .....297

energy balance .....150

energy cost .....47, 77, 84, 337

energy expenditure .....63, 70, 96, 103, 173, 199, 275

energy metabolism .....86, 318

energy storage .....48

energy supply .....57, 202

environment .....46, 47, 330, 441

eosinophil .....29

epidemiology ...23, 172, 364, 442

epistemology .....385

EPO overexpression .....140

ergogenics .....450, 455

ergometer .....306

ergometer exercise .....66

ergometric testing .....68

ERP .....310

erythropoietin .....245

estimation of work load .....370

estrogen .....43

ethical values .....415

ethics .....141, 142, 213, 222, 286, 331

ethnicity .....17, 475

EU enlargement .....277

Eurofit Tests .....68, 92, 447

European higher education area .....413

European Union .....414

European Year .....294

evolutionary medicine .....463

excessive erythrocytosis .....140

excitability .....33

excursion .....319

exercise ....10, 28, 30, 31, 32, 43, 71, 73, 78, 83, 86, 89, 115, 144, 159, 184, 186, 195, 204, 208, 219, 232, 246, 263, 320, 321, 351, 352, 386, 408, 441, 448, 452, 453

exercise capacity .....237

exercise consultation .....51

exercise hyperpnea .....341

exercise immunology .....29, 376

exercise physiology .....338

exercise prescription .....384

exercise response .....139

exercise therapy .....36

exhaustion .....373

expectations .....393

experience .....282

exploration .....171

explosive muscle contraction .223

explosive power .....249, 302

explosive strength .....58, 133

explosive training .....160

external loads .....203, 298

external workload .....226

extracellular matrix .....390

extracellular potassium .....70

**F**

fairness ...38, 163, 417, 418, 424, 473

falls .....443

family .....474

fartlek .....69

fascicle .....328

fat distribution .....94, 243

fat metabolism .....11, 28

fat oxidation .....249

fatigue ....33, 62, 77, 80, 96, 175, 205, 242, 270, 278, 296, 328, 348, 354, 359, 367, 395, 421

fatty acids .....247

fear of injury .....120

feedback system .....306

feed-forward .....371

female athletes .....183

female students .....64

females .....43, 158, 292

fencing .....58

FFA .....13

fiber recruitment .....156

fibre type .....70, 242, 303

fibromyalgia .....354

field hockey .....109, 161, 227

field measurements .....48

field testing ....177, 234, 291, 449

figuration .....271

fin swimming .....259

fine wire electrode .....262

finite element method ...136, 307, 476

firearms .....197

firefighters .....449

fitness ...102, 232, 269, 273, 434, 447

fitness activity .....407

fitness tests .....162

fixation .....266

flexibility .....297

flexible lumbar corset .....124

flight time .....62

flow-volume .....74

fluctuations .....171

fluid .....184

fluid accumulation .....378

fluid ingestion .....244

fMRI .....197

folk dance .....65

foot loading .....19

football 42, 64, 68, 106, 121, 145, 236, 330, 332, 419

footwear .....388

force analysis .....133

force measurement .....21

force plate .....21

force production .....25

force recovery .....73

forkhead transcription factor FoxO .....186

forward model .....371

Fourier analysis .....389

fractal analysis methods .....352

fracture .....136

fracture healing .....21

frail elderly .....170

freestyle flip turn .....306

frequency .....162, 303

frequency-time analysis .....302

friendship .....112

functional abilities ..120, 170, 268

functional electrical stimulation 32

functional joint stability .....40

functional status .....398

functional therapy .....148

futsal .....279, 431

**G**

gait .....19, 22, 302, 408, 435

gait analysis .....40, 129, 304

game analysis 191, 229, 241, 335, 342

game indicators .....335

game observation system .....334

game performance .....241

game play load .....231

game positions .....240

game sports .....342

game theory .....123

games .....334

gas exchange .....407

gender .....17, 103, 159, 393

gender coverage .....168

gender difference ...37, 287, 288, 424, 470, 472

gender perspective .....271

gene expression .9, 57, 138, 159, 208, 321, 454, 455

general practice .....151

generalized motor program ...371

genes .....330

genes polymorphisms .....187

genetics .....185, 331, 456

- ghrelin .....376  
 girls .....68, 448  
 glucose .....13  
 glutathione .....320  
 glycaemic index .....459  
 golf .....114, 265, 310  
 government .....164  
 GPS .....107, 129, 231  
 graded run .....132  
 graft .....266  
 grip strength .....259  
 gross motor skills .....356  
 ground reaction force .....40, 304  
 group dynamics .....338  
 group-cohesion .....312  
 groupware .....190  
 growth .....124, 389  
 growth hormone .....28, 257  
 gymnastics .....120, 121, 133, 135,  
 142, 189, 198, 283, 315, 316,  
 317, 339  
**H**  
 H reflex .....174  
 habits .....146  
 halteres .....387  
 hamstrings .....137, 437  
 hand .....176  
 handball 54, 58, 59, 92, 118, 120,  
 123, 129, 163, 172, 227, 274,  
 299, 334, 335, 346, 347, 372,  
 475  
 handicapped .....118, 213, 460  
 hats .....263  
 head posture .....302  
 health .....45, 102, 173, 268, 351,  
 355, 356, 393, 446, 447, 464  
 health directed intervention .....151  
 health level .....428  
 health promotion .....90, 110, 151,  
 152, 444, 445  
 health-enhancing physical activity  
 .....24  
 health-related fitness .....24, 272  
 health-related physical activity  
 .....162, 220  
 health-related physical fitness 274  
 healthy lifestyle .....269  
 heart cycle .....300  
 heart disease .....138  
 heart failure .....187  
 heart rate .....16, 63, 81, 97, 101,  
 106, 173, 245, 253, 263, 313,  
 331, 353, 363, 429, 437, 440,  
 464  
 heart rate reserve .....433  
 heart rate variability .90, 237, 250,  
 251, 291, 326, 327, 352, 353,  
 369, 411, 412  
 heat .....315  
 heat exchange mask .....250  
 heat illness .....259  
 heat shock protein .....452  
 hemiparesis .....278  
 HEPA .....23, 152  
 high altitude .....30, 139, 253  
 high altitude training .....139  
 high intensity training .....139, 354  
 high performance .....59, 297  
 higher education .....112  
 hiking .....274  
 hip .....44  
 hip abductor .....44, 398  
 hip arthroplasty .....398  
 hip joint .....44, 215, 357  
 hip prosthesis .....130  
 history ....188, 189, 220, 423, 453  
 hockey .....122  
 hopping .....126, 327  
 hormonal maturation .....261  
 hormonal regulation .....380  
 hormonal responses .....375  
 hormonal therapy .....404  
 hormone sensitive lipase .....11  
 hormones .50, 187, 199, 219, 377  
 horse .....369  
 HSP72 .....86  
 human movement .....20  
 human skeletal muscle .....11  
 humidity .....244, 401  
 hurdle sprint .....224  
 hydration .....315  
 hydrogen ions .....28, 411  
 hypercholesterolemia .....361  
 hypermobility .....297  
 hypertension .....326, 352, 437  
 hyperthermia .....86, 205  
 hypertriglyceridemia .....361  
 hypertrophy .....99, 205, 252, 260,  
 353, 378, 475  
 hypokinesia .....368  
 hypothalamus .....309  
 hypoxia .....57, 140, 375, 459  
**I**  
 ice hockey .....99, 161, 402, 434  
 icing .....95  
 idiopathic scoliosis .....19  
 IGF .....199  
 IGFBP 4 .....154  
 IGF-I .....138, 154, 169, 186  
 IL-6 .....195, 208  
 imitation exercises .....211, 336  
 immediate feedback .....131  
 immersion .....403, 409, 437  
 immobilisation .....50  
 immunoglobulin A .....99  
 immune function ....173, 195, 337,  
 364  
 immune response .....185  
 immune system .....105, 219  
 immunity .....12, 82, 99, 433  
 immunoglobulin .....29  
 immunohistochemistry .....360  
 immunology .....195  
 immunosuppression .....98  
 improvisation .....428  
 impulse .....132  
 IMTG .....10  
 inactivity .....24  
 inclusion policies .....17  
 incremental exercise .....263  
 individual sports .....330  
 individuality .....170, 464, 465  
 individualized approach .....113  
 inflammation .....321, 391  
 information asset management  
 .....165  
 information centre .....287  
 information management .....180  
 injury .....41, 42, 43, 92, 129  
 injury prevention .....193, 402  
 in-line skating .....60  
 insulin .....87  
 insulin resistance .....10, 386  
 insulin sensitivity .....380  
 insulin-like growth factor I .....360,  
 455  
 integrated planning .....430  
 integration .....16, 212, 213  
 intellectual abilities .....235  
 intellectual capital .....165  
 intelligence .....113  
 intensity ..34, 162, 228, 319, 327,  
 362, 382, 437  
 intensive exercise .....89  
 intensive training .....35  
 intention .....164  
 intercultural research .....280  
 interdisciplinarity .....309, 310  
 interleukin-12 .....12  
 interleukin-6 .....77  
 interlimb coordination .....279  
 inter-limb coordination .....281  
 intermittent claudication .....354  
 intermittent exercise .....206, 259,  
 382, 469  
 intermittent training .....255  
 internal forces .....20  
 internal loads .....203, 298  
 international comparison .....426  
 international rugby union .....431  
 internet .....110, 189  
 internet training .....190  
 interval anaerobic test .....229  
 interval endurance capacity ...226  
 interval hypoxic-hypercapnic  
 training .....353  
 interval sprint capacity .....226  
 interval training .....28, 415  
 intervention .....46, 115, 332  
 intracellular cytokines .....82  
 intramuscular triacylglycerol ..247  
 intrinsic motivation .....164, 285  
 inverse dynamics .....20  
 inverse model .....371  
 in-water ergometry .....370  
 isokinetic dynamometry .....390  
 isokinetic exercise .....97  
 isokinetic moment .....368  
 isokinetic strength .....135, 346  
 isokinetic testing .....314  
 isokinetics .....91, 299, 347, 362  
 isometric contraction .....75  
 isometric endurance .....253  
 isometric force .....132  
 isometric strength .....13  
 isometrics .....42, 301, 395  
 IZOF .....116, 216, 333  
**J**  
 joint replacement .....21  
 joint wear .....357  
 judging .....469  
 judo .....280, 371, 421, 461  
 jumping tests .....236  
 jumps .....62, 242  
 junior athletes .....179, 338, 441  
 justice .....141  
**K**  
 karate .....232  
 kinematic analysis ...34, 128, 304  
 kinematic data acquisition ....108  
 kinematics .....129, 295, 300  
 kinesio taping .....34  
 kinetic chain .....91  
 kinetics .....267, 296  
 knee .....41, 358, 397, 471  
 knee arthroplasty .....357  
 knee extensors .....175  
 knee injuries .....43, 402  
 knee joint .....40, 405  
 knee joint stabilisation .....347  
 knowledge of results .....278  
 Kohonen network .....342  
 korfbal .....115  
 KT1000 .....97

## L

lactate ..... 80, 206, 251, 254, 262, 369, 371, 406, 440  
lactate removal .....52, 318  
lactate threshold .....81, 200, 341, 407  
lactate turn point .....83  
L-arginine-L-aspartate .....455  
Laser Doppler Spectroscopy .....399  
lean mass .....37  
learning .....59, 163  
left ventricular function .....265  
leg stiffness .....327  
leg strength .....368, 439  
leisure-time .....269, 283  
leisure-time activity 106, 311, 474  
length-tension .....254  
leptin ..... 83, 94, 258, 376, 446  
less privileged countries .....282  
leukocytes .....57, 77  
leukocytosis .....391  
level of qualification .....258  
library .....287  
life saving .....293  
lifelong participation .....393  
lifestyle ..... 273, 275, 478  
lifestyle intervention .....15  
ligaments .....128, 159  
lipid metabolism .....10  
lipid peroxidation .....88  
lipids .....386  
lipolysis .....11, 386  
lipoprotein profiles .....439  
loads ..... 302, 313, 357  
local curriculum .....423  
local position measurement .....191  
locomotion .....23  
locomotor system .....221  
long distance running .....66, 382, 407  
long jump .....135, 297  
longitudinal variability .....374  
low back pain ..... 136, 235, 366  
low intensity exercise .....240, 443  
lower limb .....160  
LTM .....248  
lumbar disc surgery .....148  
lumbo-sacral pain .....400  
lung disease .....19, 351  
LVH .....99  
lymph flow .....73  
lymphocytes .....140

## M

m. biceps femoris .....161  
m. deltoides .....137  
m. pectoralis major .....137  
m. quadriceps femoris .....405  
m. triceps brachii .....70, 242  
m. triceps surae ..... 175, 243, 368  
macrophage .....364  
macroscopy .....75  
magnetic resonance spectroscopy .....78  
manual therapy .....127, 366  
marathon .....368, 442  
marching .....253  
massage .....397, 400  
master .....103  
matrix metalloproteinases .....204  
maturation .....228, 356  
maturation stages .....448  
maximal accumulated O<sub>2</sub> deficit .....139  
maximal anaerobic power .....124  
maximal exercise .....75, 258

maximal exercise capacity .....392  
maximal force .....91, 160  
maximal heart rate .....264, 272  
maximal lactate steady state .....160, 267, 313, 318  
maximal oxygen uptake .....264, 291, 381  
maximal torque .....347  
maximal voluntary contraction .....90, 345  
measurement techniques .....21  
measurement units .....339  
mechanical effectiveness .....295  
mechanical energy .....127  
mechanical load .....232, 315  
mechanical power .....307  
mechanical stimulation .....384  
mechanics .....194  
mechanisms .....364  
mechanomyogram .....32  
medical students .....434  
medicine .....452  
medley .....228  
menstruation .....150, 269, 356  
mental .....406  
mental health .....115, 119  
mental imagery .....197  
mental rehearsal .....216  
mental representation .....197, 198  
mentally retarded .....421  
metabolic characteristics .....244  
metabolic energy .....127  
metabolic response .....228  
metabolic stress symptoms .....374  
metabolic syndrome .....386  
metabolism .....29, 50, 246, 457  
metabolism disorders .....100  
metacarpi bone .....136  
metacognition .....115  
metalloproteinase-2 .....186  
metatarsal .....261  
MHC .....178, 260  
microcirculation .....399  
mid-age .....102, 407  
middle distance running .....238  
military .....253  
minimal brain dysfunction .....399  
minorities .....146  
mitochondria .....31, 32  
mitochondrial biogenesis .....31  
mitochondrial myopathy .....78  
MMM-2 .....186  
mobility of roles .....417  
model theory .....141  
modelling .....67, 144, 171, 232, 342, 381, 387  
moderate altitude .....250, 274, 374, 408  
modernity .....213  
modes of exercise .....264  
modification .....20  
monitoring .....24, 121, 203  
monocytosis .....391  
mood .....444  
mood state .....107, 309, 412  
moral education .....222  
moral education program .....425  
moral functioning .....311  
morphology .....65, 466  
mortality .....463  
motion analysis .....346  
motion anticipation .....117  
motion pattern .....148  
motivation .....118, 119, 121, 281, 331, 428  
motivational climate .....311

motivational imagery .....108  
motives .....428  
motor abilities .....58, 68, 220, 221, 225, 233, 289, 427, 435, 441, 466  
motor activity .....290, 419, 464  
motor control .....110, 150, 197, 198, 223, 256, 278, 338  
motor coordination .....221  
motor efficiency .....64  
motor learning .....109, 170  
motor performance .....228, 449, 455  
motor qualities .....417  
motor skill .....279, 432  
motor testing .....292  
motor typologies .....68  
mountaineering .....373  
movement analysis .....136, 344  
movement pattern .....130  
movement perturbation .....277  
movement preprogramming .....277  
movement representation .....150  
Mozart effect .....474  
MRCP .....310  
MRI .....266, 353  
mucosal immunity .....196  
multiculturalism .....146  
multidimensional performance characteristics .....161  
multi-joint exercise .....298  
multilateral cooperation .....277  
multimedia .....122, 189  
multiple sclerosis .....403  
multisensory integration .....196  
muscle .....11, 31, 32, 79, 80, 86, 98, 138, 153, 169, 171, 182, 186, 195, 206, 208, 210, 216, 219, 247, 260, 309, 324, 327, 360, 367, 394  
muscle activation .....174  
muscle activity .....402  
muscle architecture .....132  
muscle balance .....475  
muscle blood flow .....73  
muscle compound action potential .....359  
muscle cramps .....314  
muscle damage .....71, 73, 86, 199, 223, 246, 390, 391  
muscle degeneration .....140  
muscle differentiation .....329  
muscle efficiency .....33  
muscle endurance training .....73  
muscle exertion .....98  
muscle fatigue .....32, 70, 84, 328, 345, 347  
muscle fibre .....186, 262  
muscle force .....304  
muscle history .....328  
muscle inhibition .....379  
muscle injury .....132  
muscle mechanics .....21  
muscle metabolism .....10  
muscle oxidative capacity .....73  
muscle oxygen consumption .....183  
muscle oxygen saturation .....257  
muscle oxygenation .....392  
muscle perfusion .....266  
muscle pH .....73  
muscle properties .....155, 238, 329  
muscle proteins .....86  
muscle size .....299  
muscle strength .....19, 40, 91, 97, 148, 181, 217, 264, 347, 450, 472  
muscle stretch .....327

- muscle sympathetic nervous activity .....352  
muscle temperature .....74  
muscle tenderness .....390  
muscle tendon .....159  
muscle tuning .....153, 154  
muscle-tendon behavior .....298  
muscle-tendon unit .....48, 296  
muscular failure .....389  
muscular metabolism .....65  
musculoskeletal loading .....21  
M-wave .....381  
myoblast .....208  
myocardium .....71  
myofibrillar remodeling .....246  
myosin .....138
- N**  
national identity .....168  
near infrared spectroscopy .....183, 263  
neck position .....398  
neck posture .....302  
necrosis .....28  
negative feedback loop .....300  
netball .....67  
netscape sports .....111  
neural activation .....25, 44, 175  
neural adaptations .....181  
neural cardiovascular regulation .....326  
neural networks .....342  
neural plasticity .....182  
neural stimuli .....474  
neuroendocrinology .....149, 150, 200, 219  
neurological rehabilitation .....403  
neurology .....396, 411  
neuromuscular activity .....124  
neuromuscular adaptation .....181, 217, 223, 392  
neuromuscular adjustments .....84  
neuromuscular characteristics .....291  
neuromuscular control .....76, 205, 224  
neuromuscular diseases .....384  
neuromuscular facilitation .....437  
neuromuscular fatigue .....223, 337, 375  
neurophysiology .....150  
newspapers .....293  
NIDDM .....438  
non-athletes .....111  
non-elite .....371  
nonlinear dynamics .....381  
non-specific training .....417  
nordic walking .....33  
notation analysis .....123, 289, 338  
nutrition .....55, 91, 92, 183, 195, 324, 325, 457, 459, 462, 463  
nutritional assessment .....458, 460  
nutritional habits .....460  
nutritional intake .....457, 461
- O**  
obesity .....14, 106, 156, 158, 275, 356, 386, 435, 441, 442, 445, 476  
object recognition .....344  
objective measurement .....173  
observation of human movements .....197  
observer reliability .....123  
oculo-cardiac reflex .....101  
Olympics .....168, 180, 293, 335, 365, 426, 470  
on-line control .....108  
on-line coverage .....167  
on-line feedback .....194  
optic fibre .....128  
optoelectronic analysis .....135, 472  
oral breathing .....302  
orientation motivation .....417  
orienteering .....79  
orthostatic tolerance .....377  
orthotics .....296  
ortica mapping .....310  
osteoarthritis .....404  
overarm throwing .....110, 134  
overlearning .....280  
overreaching .....218  
overtraining .....51, 200, 218, 219, 237, 318, 436  
overuse injury .....41  
overweight .....15, 90, 106, 275, 361, 442  
oxidative metabolism .....80, 245  
oxidative phosphorylation .....340  
oxidative stress .....87, 89, 318, 321, 452, 453  
oxygen consumption .....79, 381, 388  
oxygen kinetics .....245  
oxygen requirement .....84  
oxygen uptake .....61, 141, 200, 340, 360, 381, 382, 394  
oxygenation .....469
- P**  
pain .....39, 100  
paradigms of sport science .....188  
paralanguage .....168  
paralympic athletes .....92  
parental support .....143  
parents .....192  
Parkinson's disease .....156  
participation motives .....120  
partnership .....143  
passive drag in water .....27  
patellar tendon .....75  
patellofemoral pain syndrome .....306  
pathological effect .....450  
patients .....341, 350  
pattern .....26  
pattern recognition .....224, 304, 370, 410  
patterns of play .....301, 431  
peace .....213  
peak power .....79  
pedagogical contents interventions .....426, 430  
pedagogics .....420, 468, 478  
pedalling .....26  
pedalling rate .....128  
peers .....112, 193  
perceived exertion .....84, 115, 469  
perceived fitness .....14  
perceived readiness .....415  
percent body fat .....94  
perception of effort .....82  
perception-action .....196  
perceptual training .....332  
performance .....29, 56, 74, 100, 114, 123, 255, 278, 312, 319, 321, 322, 330, 331, 362, 373, 380, 400, 436, 451, 455, 456, 474  
performance athletes .....379  
performance decrement .....340  
performance diagnostics .....202, 203, 318, 334, 346  
performance outcome .....332  
periodisation of training .....176, 233  
personal models .....429  
personality .....282, 309, 310  
personality traits .....121  
persuasion .....114  
perturbation .....124, 174, 334  
PET .....13, 34  
PGC-1 .....31  
pH .....52  
pharmacological blocking .....51  
phenomenology of performance .....293  
philosophy .....142, 286, 385  
phosphocreatine resynthesis .....52, 206  
physical abilities .....179  
physical activity .....15, 24, 47, 90, 96, 99, 102, 103, 104, 105, 119, 152, 164, 172, 173, 212, 214, 257, 269, 272, 273, 275, 276, 280, 281, 351, 355, 357, 404, 427, 432, 433, 434, 440, 443, 448, 460, 463, 470, 475, 478  
physical activity levels .....220, 268, 447  
physical control .....405  
physical education .....38, 39, 163, 164, 188, 215, 220, 271, 273, 285, 287, 289, 393, 414, 416, 418, 420, 421, 422, 423, 424, 426, 427, 432, 447, 470, 471, 472, 473, 477, 478  
physical education students .....220, 478  
physical efficiency .....421  
physical exercise .....101, 105, 117, 463  
physical fitness .....14, 15, 35, 79, 93, 102, 157, 162, 173, 211, 215, 356, 431, 436, 445, 470  
physical growth .....233  
physical inactivity .....9, 138  
physical literacy .....163  
physical load .....450  
physical maturation .....261  
physical performance .....68, 108, 156, 187, 290, 460  
physical self-concept .....109  
physical stress .....394  
physical structure .....60  
physical therapy .....42, 248  
physical working capacity .....66  
physically disabled adolescent .....425  
physiological parameters .....424  
physiological performance .....412  
physiological profile .....251  
physiological response .....84, 362  
physiology .....202  
physiology response .....210  
physiotherapy .....400  
plantar fasciitis .....372  
plasma fatty acids/tryptophan .....35  
plasma fibrinogen .....209  
plasma viscosity .....209  
plasticity .....22  
platelet aggregation .....88  
play .....343  
plyometry .....155  
political background .....294  
polymorphism .....185  
popular press .....167  
population health .....9, 47  
portfolio .....421  
position pattern recognition .....229  
postisometric relaxation .....400  
postmenopause .....100  
post-operative .....18  
postprandial lipemia .....104

- postural stability .....18  
 posture .....106  
 potassium .....96, 359, 360  
 potentiation .....379  
 power .....88, 239, 305  
 power analysis .....362  
 power output .....57, 246, 319, 361  
 power training .....181  
 PPARgamma .....208  
 practical examples .....162  
 praxis communication .....168  
 pre- and post-professionalism .....431  
 pre-adolescent children .....311  
 prediction .....272, 330, 340  
 pregnancy .....103  
 preparation period .....227, 230  
 prepubescent children .....355, 436  
 preschool children .....356, 422  
 prevention .....224, 355  
 primary school .....152, 414, 423  
 prior aerobic load .....81  
 prior exercise .....72, 156  
 problem solving .....115  
 procedural skill .....280  
 process oriented analysis .....336  
 profession .....143  
 professional deontology .....284  
 professional orientation .....466  
 professional preparation .....283  
 professionalization .....477  
 program quality .....414  
 prolonged exercise .....401  
 promotion .....46, 268, 447  
 promotion strategy .....464  
 propagation .....49  
 proprioception .....235, 236, 404  
 prostaglandins .....139  
 protection .....70  
 protein .....52, 246  
 protein requirement .....170  
 protein supplementation .....205  
 protein synthesis .....324  
 proteinuria .....87  
 PSQ .....136  
 psychological response .....412  
 psychological stress .....433  
 psychological training .....121  
 psychology .....114, 116, 363  
 psychomotor abilities .....235  
 psychomotor development .....110  
 psychomotor patterns .....212  
 psychomotor skills .....422  
 psychomotor therapy .....144  
 psychophysiology .....412, 431  
 psychosocial rehabilitation .....144  
 psychosociology .....191, 305  
 public health .....23, 281  
 public policies .....283  
 pulmonary gas exchange .....341  
 pulse sums .....84  
 pumping movement .....61  
 push-up .....388
- Q**  
 Qigong .....157  
 quality control .....407  
 quality management .....166  
 quality of life .....145, 156, 398, 441, 475  
 quality of sleep .....274  
 quality press .....167  
 quantitative analysis .....469  
 questionnaire .....109, 172, 214, 397, 428
- R**  
 race performance .....54  
 racial harmony .....167  
 radiogrammetry .....37  
 Ramadan fasting .....464  
 randomized trial .....110  
 range of motion .....267  
 rappelling .....394  
 rate of force development .....50  
 rate of perceived exertion .....363  
 rating .....163  
 reaction time .....68, 117, 176, 279, 280  
 reactive oxygen species .....453  
 readiness .....406  
 realtime position analysis .....191, 342  
 rebound hypoglycemia .....325  
 rebreathing .....139  
 recovery .....109, 251, 391, 406  
 recreational sport .....449  
 recruits .....450  
 rectal temperature .....81, 259, 409  
 red pepper .....183  
 redox sensors .....87  
 redox-sensitive transcription factors .....320  
 reduced breathing .....257  
 redundancy .....341  
 REE .....248  
 reflex .....197, 205  
 reflex gain .....256  
 reflex modulation .....22  
 reflex sensitivity .....328  
 regeneration .....98  
 regional brain activity .....34  
 rehabilitation .....40, 145, 187, 205, 248, 270, 350, 357, 372, 374, 384, 385, 396, 405  
 rehabilitation program .....157  
 rehydration .....184  
 religion .....294  
 repeated apneas .....260  
 research applications .....216  
 research issues .....216  
 resistance exercise .....19, 160, 170, 375, 444  
 resistance strength training .....18, 61, 169, 181, 252, 351, 438, 439, 444, 446  
 resonance .....216  
 respiration .....250, 340, 383  
 respiratory acidosis .....257  
 respiratory compensation .....252, 341, 411  
 responsibility .....284  
 rest heart rate .....407  
 resting energy expenditure .....249  
 retrospective scale .....331  
 RFD .....223  
 rheumatoid arthritis .....100  
 rhythm .....126  
 rhythmic gymnastics .....242, 281  
 risk factors .....51, 151  
 rock climbing .....254  
 rolimeter .....97  
 roller hockey .....231, 430  
 room calorimeter .....85  
 rotation .....49  
 rowing .....27, 121, 187, 258, 306, 319, 452  
 RPE .....108  
 rugby .....179, 222, 289, 389  
 rules .....289, 424  
 running .....37, 46, 47, 48, 49, 78, 111, 129, 153, 209, 217, 244, 292, 297, 388  
 running adaptation .....52  
 running economy .....48  
 running shoes .....130, 322  
 rural girls .....274  
 Rushall's model .....121
- S**  
 safety .....366, 377  
 sailboard .....61  
 salivary IgA .....196  
 salt-water-balance .....376  
 sarcomere disruption .....390  
 sarcopenia .....170, 350  
 sarcoplasmic reticulum .....87  
 satellite cells .....186  
 sauna .....100  
 scale of values .....415  
 scanning .....198  
 SCAT .....116  
 school children .....232, 431  
 school sports .....173  
 swimming of disabled .....136  
 science .....385  
 scouting .....123, 477  
 scuba diving .....259  
 secondary school .....414, 427  
 secondary students .....469  
 sedentary behaviour .....45  
 selection .....331  
 selection year .....54  
 self-concept .....38  
 self-confidence .....331  
 self-controlled training .....14  
 self-efficacy .....120, 422  
 self-esteem .....144, 418  
 self-paced walking .....61  
 self-perception .....232, 288, 333  
 self-realisation .....431  
 self-regulation .....116  
 self-stability .....171  
 sensomotor training .....44, 174, 178, 223  
 sensor monitor .....104  
 serotonin .....150, 184  
 serum electrolytes .....314  
 sex .....158  
 sexual harassment .....147  
 sexual roles .....419  
 sexual stereotypes .....419  
 SF-36 .....281  
 shear stress .....378  
 schizophrenia .....446  
 shock waves .....49  
 shoot boxing .....233  
 shooting .....250, 300  
 shooting technique .....336  
 short term memory .....198  
 shot put .....70  
 shoulder .....39, 267, 299, 347, 475  
 shoulder resistance exercise .....398  
 shuttle run .....69, 227  
 sidestep cutting manoeuvre .....160  
 simulation .....153, 238, 316, 318  
 sinusoidal perturbations .....125  
 skating .....194  
 skiing .....194, 210, 338, 344  
 ski-jumping .....194, 345, 365  
 skill learning .....182  
 skill management .....166  
 skills .....278, 389, 458  
 skinfold thickness .....76, 243  
 ski-touring .....127  
 slalom .....295  
 sleep .....92  
 slip .....124  
 slow component of oxygen uptake .....201

- smoking .....89, 381  
snowmobile .....41  
soccer .....67, 69, 80, 160, 184, 226,  
228, 230, 235, 240, 241, 243,  
285, 338, 362, 363, 409, 438,  
451, 458, 462, 467, 474  
soccer kick .....295  
soccer training .....98  
social background .....309  
social characteristics .....287  
social environment .....419  
social integration .....17, 167  
social learning .....162  
social maturity .....421  
social policy .....16  
social pressure .....282  
social representation .....288  
social skills .....111  
social values .....285  
society .....147, 168  
sociology .....393  
socks .....244  
soft computing .....272  
somatic status .....221  
somatization .....19  
somatotype .....78, 465  
sonophoresis .....270  
spastic hypertonia .....305  
specialized communication area  
.....168  
specificity .....110, 363  
spectral analysis .....443  
spectroscopy .....469  
speech production .....252  
speed skating .....124, 231, 298, 321  
speed specificity .....379  
speed strength .....58, 345  
spinal cord injury .....88, 381  
spine .....289, 366  
spine mobility .....148  
spiroergometry .....74, 370, 371  
splanchnic circulation .....245  
spleen response .....260, 406  
spontaneous exercise .....256  
sport .....294  
sport activity .....468  
sport career .....191, 192, 287  
sport clubs .....147, 212, 284  
sport drink .....455  
sport education .....112  
sport equipment .....323, 366  
sport for disabled .....27, 213  
sport initiation .....284  
sport injuries .....66  
sport investigation .....294  
sport opportunities .....17  
sport participation .....17, 281  
sport performance .....194, 335, 343  
sport policy .....17, 146, 167  
sport psychology .....216  
sport sociology .....350  
sport structures .....277  
sport success .....143  
sport therapy .....396  
sport traumatology .....40  
sporting jobs .....284  
sports drinks .....325  
sports medicine .....42, 113  
sports wear .....131  
sportsmen .....254  
sprint .....80, 82, 133, 134, 305, 379  
squad system .....290  
squad transitions .....290  
squash .....458, 466  
stabilometry .....399  
stable isotopes .....158, 209  
start technique .....126  
startle response .....277  
state sport confidence .....114  
static MVC .....253  
steadiness .....44  
step activity monitor .....295  
stiffness .....47, 48, 125, 133, 155,  
247  
strain .....154  
strategy .....100, 118  
strategy for health .....468  
strength .....50, 57, 131, 178, 230,  
242, 243, 256, 314, 358  
strength endurance .....358  
strength exercises .....44  
strength gain .....61, 240  
strength measurement .....262  
strength training .....55, 132, 178,  
182, 206, 218, 268, 291, 354,  
378, 396, 403, 411, 467  
strength values .....161  
strength-endurance training .....228  
stress .....109, 307  
stress and displacements .....476  
stress fracture .....261  
stress hormones .....94  
stress proteins .....391  
stretch reflex .....174  
stretching .....437  
stretch-shortening cycle .....47, 205,  
297, 306, 392  
stroke .....248, 396, 411  
stroke parameter .....179, 339  
structure analysis .....64  
students .....236, 430  
subjective feelings .....455  
subjectivity .....164  
subject-object interrelationship  
.....415  
submaximal exercise .....459  
submaximal VO .....157  
substances .....104  
substrate metabolism .....158, 325  
substrate utilisation .....459  
sudden death .....476  
sunglasses .....263  
superslow .....61  
supine floating .....273  
supplementation .....412  
supplements .....324  
surfing .....249, 433  
survey .....269  
swimming .....12, 56, 66, 127, 131,  
134, 141, 203, 228, 257, 267,  
293, 306, 310, 339, 376, 387,  
406  
swing .....133  
swingplane .....126  
sympathetic nervous system .....394  
synchronized swimming .....56  
**T**  
T/M genotype .....453  
table tennis .....191, 440  
tactical moves .....370  
Tae Bo .....35  
tailored interventions .....144  
take-off angle .....126  
talent .....54, 161, 340  
talent care .....414  
talent development .....193  
talent selection .....54, 67, 69, 109,  
330, 416  
talented young athletes .....143  
talk test .....252  
tape .....222  
tapering .....234  
taping .....42  
teacher .....414, 416  
teacher training .....415  
teacher's activities .....418, 466  
teachers' attitudes .....421  
teacher's role .....417  
teaching .....163, 422, 428, 429  
teaching skills .....163  
teaching unit .....473  
team sport game .....343  
team sports .....231  
technical analysis .....116  
technical measurements .....135  
technical skills .....241  
technique .....27, 49, 316, 317  
technique training .....231  
technology .....321, 322  
temperature .....247  
temperature regulation .....244  
tendinopathy .....41, 385  
tendon .....204, 434  
tendon forces .....21  
tendon structures .....247  
tennis .....59, 124, 142, 286, 305,  
338, 441, 466  
tennis training .....59  
tensiomyography .....161, 329  
testing .....54, 59, 65, 67, 69, 178,  
200, 225, 230, 232, 234, 238,  
239, 266, 271, 291, 330, 345,  
420, 426, 464, 467  
testosterone .....200, 270, 408  
theory and practice .....215  
theory of planned behavior .....311  
therapeutical shoes .....148  
therapy .....385  
thermal .....259  
thermal load .....86  
thermoregulation .....36, 184, 244,  
368  
time balance assessment .....415  
time series .....149, 199  
time trial .....362  
tissue oxygenation .....263  
tissue response .....315  
tissue vibrations .....154  
top performances .....322  
torque-velocity relationship .....26  
total antioxidant status .....83  
total knee arthroplasty .....40  
tourism .....449  
tournament .....42, 92  
track and field .....432  
tracking .....162, 191, 238, 395  
training .....16, 33, 36, 57, 64, 67, 80,  
85, 93, 97, 111, 178, 204, 218,  
219, 234, 239, 240, 241, 247,  
256, 257, 261, 326, 351, 363,  
377, 379, 384, 386, 453, 459,  
465, 472  
training control .....298  
training cycle .....66  
training diaries .....234, 340  
training effects .....33, 230  
training frequency .....378  
training load .....82, 392  
training monitoring .....203, 452  
training process intensification .....58  
training program .....35  
training regimen .....237  
training response .....180, 369  
training theory .....309  
training volume .....94  
training zones .....226



- transcranial magnetic stimulation .....176, 182  
transcription .....31  
transducers .....21  
transitions .....192  
transmitter .....229  
treadmill running .....49  
treadmill walking .....77  
T-reflex .....381  
tremor .....389  
trends .....287, 413  
triacylglycerol .....11, 104  
trial performance .....177  
triathlon ..... 52, 54, 100, 149, 257, 313, 319, 408  
trigger release .....300  
triple jump .....304  
triteness .....295  
T-tubules .....360  
turn point concept .....384  
turning preference .....49  
 $\dot{V}O_2\max$  .....382  
twins .....59  
twitch interpolation .....175  
type II diabetes .....403  
type IV collagen .....186  
typology .....420
- U**  
UKK walking test .....240  
ultra-endurance .....52  
ultra-marathon .....107  
ultra-marathon cycling .....437  
ultrasonography .....154, 328  
ultrasound ..... 260, 298, 406  
ultraviolet radiation .....263  
undergraduate students .....289  
underwater testing .....259  
underwater torque .....134  
unloaded movement velocity .....178  
unpaid leadership .....166  
unstable external object .....300  
untrained subjects .....63, 262
- upper body .....336  
urban girls .....274  
urinary electrolytes .....81  
urological tumor .....36
- V**  
validation ..... 177, 214, 407, 428  
value differentiation .....222  
values .....38, 143, 423  
variability .....25, 171  
variability of performance .....114  
variability profiles .....108  
variations .....172  
vascular endothelial growth factors .....207  
vascular permeability .....95  
vascular unloading .....83  
vasoconstriction .....441  
vectorcardiography .....99  
velocity .....110  
ventilatory limitation .....30  
ventilatory threshold .....435  
vertical jump .....60, 160, 239, 346  
vibration .....216, 217, 301, 377, 379  
vibration exercise .....217  
vibration training .....218, 378  
vibrations .....153  
victory .....38  
video .....344  
violence .....280  
virtual campus .....165  
virtual reality .....343  
visual motor coordination .....176  
visualisation techniques .....304  
vitamin C .....87, 185, 320  
vitamin E .....185  
vitamins .....89, 459  
 $VO_2$  .....434  
 $VO_2$  kinetics .....72, 383  
 $VO_2$  slow component .....156, 381  
 $VO_2\max$  .....62, 255, 336, 395, 450  
 $VO_2\text{peak}$  .....354
- volleyball .....238, 239, 268, 370, 425, 429
- W**  
walking .....15, 22, 82, 154  
warm-up .....74, 425  
water depth .....75  
water exercise .....399, 407  
water intake .....81  
water polo .....60, 141, 301  
water temperature .....376  
water-treadmill .....369  
wavelet analysis .....306, 410  
way of life .....417  
weartest .....130  
web lecture .....122  
weight control .....471  
weight maintenance .....156, 446  
weight reduction .....461  
weightlifting .....239, 301  
wheel running .....360, 455  
wheelchair athlete .....380  
wheelchair basketball .....336  
wheelchair ergometry .....381  
wheelchair exercise .....380  
Wingate anaerobic test .....252  
Wingate test .....246, 249, 260, 460  
winter sports .....183  
women's sport .....168  
woodball .....285  
work .....47, 132  
workload .....16, 348  
wrestling .....265
- Y**  
young athletes .....454, 459, 472, 477  
young children .....416  
young students .....432  
youth .....45, 120, 146, 161  
youth risk behaviours .....119  
youth sport .....112, 146, 166
- Z**  
zinc .....457