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ESF Exploratory Workshop on

The Future of Research in Sport Participation in the Lifespan (EW-SPiL)

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Convened by:
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BOOK OF ABSTRACT

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Definition of Sport: Diffecerences and Similarities Between Competitive Sport and Sport for All

Prof. Nicola Porro

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By a sociological point of view one must preliminarily distinguish between *Voluntarism* at large and *Voluntary Action*. Voluntarism is a social sub-system which can be described according to institutional and organizational theories. Voluntary action means a collective practice inspired to a philosophy of solidarity and to a value oriented ethics.

In Europe the sports organizations, including the most of performance competitive activities, since the late 19th century historically grounded in both the sub-system of voluntarism and the culture of voluntary action. By an organizational perspective they represented the social backbone of the sports system at large.

At present the most of European sports clubs are rooted in the non profit private domain, in the Third Sector organizational area and in the so called Social Economy.

At the same time the culture and the practice of voluntary sport have been influenced by social changes and by the uprising of new lifestyles, attitudes, preferences and tastes.

The so called *European sports system* is still strongly differentiated and reflects various and highly heterogeneous dynamics of formation and development which on turn refer to the profile of the Nation building, to specific forms of modernization, to the social stratification etc. In each country role, structure and regulation of the sport system depend on (i) different legal statuses assigned to sport; (ii) various typologies of acknowledgement of the non profit system at large; (iii) organizational histories, to be linked with specific experiences (regarding sports disciplines, network frames, influence of exogenous and endogenous factors), and on (iv) an emerging role exerted by over-national bodies like EU.

To a closer analysis of its social, cultural and organizational landscape *sport for all* itself means as an umbrella formula in which are represented many fields of action, sometimes conflicting each other. One can describe it as a typical *political arena* according to the classic Benson's definition (1988), implying different actors, several stakeholders and specific priorities and motivations. According to our approach we can locate three main organizational identities: (i) grassroots movements, (ii) sport for citizenship associations and (iii) sport for everybody offer system. On turn, changes and trends in sports organizations will be analysed adopting on one hand a socio-historical approach and, on the other, an emerging sociological analysis of organizations.

The presentation emphasizes the relationship between these conceptual and methodological contributions and the specific role of sport in producing social capital.

Possible Advances in Measuring Perticipation in Sports: Is COMPASS Project Still Effective?

Prof. Antonio Mussino

University of Rome " La Sapienza", Rome, Italy

At the beginning of the millennium it is important to focus on ***international comparisons*** of sports participation, since sport has become a ***global phenomenon***. It is drifting somehow further away from its original concept: on one hand, the difference between sports and other ***physical-motor activities*** is becoming less clear-cut; on the other hand, the gap is growing between ordinary sport and ***sport show*** sectors, that are tending to replace the principles and rules of sport with those employed in the business world. The ***new trends*** in participation (including open-air, aesthetic, keep-fit activities and so on) have contributed to ***enlarge*** the traditional field of interest of competitive, organised and goal-oriented activities.

This complexity represents a challenge for statisticians, trying to ***measure*** and to ***compare*** levels and typologies of participation in sports activities.

Europe is paying a growing attention to sports, focusing in particular on its social and cultural aspects: the Declaration on Sport adopted by the European Commission and submitted to the European Council of Nice (2000) defines an European model respectful of cultural diversity and focused on the social and educational functions of sports. Thus, the sport system moves around a very complex issue, which is increasingly difficult to classify. To face this situation it is necessary to provide clear and shared definitions and to identify suitable indicators.

Now the White Paper on Sport enforce this attention: "Its overall objective is to give strategic orientation on the role of sport in Europe, to encourage debate on specific problems, to enhance the visibility of sport in EU policy-making and to raise public awareness of the needs and specificities of the sector".

To study these trends, some years ago, was proposed and funded a research initiative ***COMPASS*** (***Co-Ordinate Monitoring of Participation in SportS***) (Gratton, 1999; Mussino, 2004). Its main goals were to examine existing systems for the collection and analysis of sports participation data and to promote ***harmonisation*** of these statistics adopting some aspects of a common methodology in the collection of survey data. So ***greater comparability*** of data from different countries would become possible. The data we are concerned with, in COMPASS, are those collected in ***national sports participation surveys,*** which use questionnaires to collect information on a range of specified sporting activities over a specified period of time.

There are other strategies to collect data: for instance ***Eurobarometer*** surveys are important tools to measure ***raw*** trends of participation, but do not allow us the possibilities to discriminate its levels, nor to individuate its determinants and help to analyse its key drivers. Also membership figures of sports organisation (i.e. ***official administrative data***), e.g. of National Olympic Committees, may be used to explain these trends, but these data have significant ***limitations***: not all members of sports clubs are

active sport participants; they include double counts; they are related to sport participation only in a competitive context.

This presentation, summarizing the strategies of comparisons of the sports systems, of the methodologies utilized in measuring participation in sports in various countries, tries to propose some new strategies, based on the General Model defined by COMPASS project.

Ethical Issues Are Inherent in Research Design and Data Analysis in Performance Enhancement Research

Prof. Greg Atkinson

John Moore University, Liverpool, United Kingdom

In this presentation, I analyse and discuss the present status of research design and analysis of performance enhancement research. I use clinical research frameworks such as phased trials and the CONSORT guidelines as 'gold standard' references. While it can be unethical to recruit too many participants in a study, the more common problem for sports scientists is the recruitment of an adequate sample size for statistical power. The worst scenario is to administer invasive and time consuming interventions and measurements to human participants with little chance of detecting statistically and practically significant effects. To avoid this worst scenario, I argue that many studies fall short of the good practice points that are now ubiquitous in clinical research. Important issues that I will cover include (i) Ethical and robust participant allocation to study groups, (ii) Ethical consideration of statistical power and (iii) practical and statistical significance. This topic is extremely relevant to this workshop since the ultimate solution to these problems may be the planning and implementation of pan-European multi-centre trials and research syntheses.

Motor Learning and Motor Development: A Special Emphasis in Children's Motor Behavior

Prof. Joao Barreiros

Technical University of Lisbon, Lisbon, Portugal

The most relevant changes in the areas of motor learning and motor development will be presented, taking into consideration the theoretical approaches and the practical implications for human movement sciences and sport sciences. The main questions under debate and the future trends for research will also be presented and discussed. This presentation will focus the implications for practice and the theoretical framework that will support research and practice in the future.

Growt, Maturation and Talent

Prof. Manuel J. Coelho-e-Silva

University of Coimbra, Coimbra, Portugal

This portion evaluates relationships among four indicators of biological maturation and concordance between classifications of maturity status in youth soccer. Data included chronological age (CA), skeletal age (SA, Fels method), stage of pubic hair (PH), predicted age at peak height velocity (PHV), and percentage of predicted adult height. Players were classified as on time, late or early in maturation with the SA-CA difference, predicted age at PHV and percentage of predicted mature height. Although the four maturity indicators were related, concordance of maturity classifications between SA and predicted age of PHV and percentage predicted mature height was relatively poor.

Participants in many youth sports are commonly combined into age groups spanning two years. To compare variation in size, function, sport-specific skill and goal orientation associated with differences in biological maturity status of youth soccer players within two competitive age groups. The sample included 159 male soccer players. Weight, height, sitting height and four skinfolds, four functional capacities, four soccer skills and goal orientation were measured. Skeletal maturity was assessed with the Fels method. Each player was classified as late, on time or early maturing based on the difference between skeletal and chronological ages. Late, on time and early maturing boys are represented among 11-12 year olds, but late maturing boys are under-represented among 13-14 year olds. Players in each age group advanced in maturity are taller and heavier than those on time and late in skeletal maturity, but players of contrasting maturity status do not differ, with few exceptions, in functional capacities, soccer-specific skills and goal orientation. Variation in body size associated with maturity status in youth soccer players is similar to that for adolescent males in general, but soccer players who vary in maturity status do not differ in functional capacities, soccer-specific skills and goal orientation

This output compares the growth, maturity status, functional capacity, sport-specific skill and goal orientation of adolescent male soccer players who at follow-up two years later discontinued participation (dropout), continued at the same level (club), and moved to a higher level (elite). Among 11-12 year old players at baseline, a gradient of elite > club > dropout was suggested for size and function, though differences were not consistently significant. The gradient of elite > club > dropout was more clearly defined among 13-14 year old players at baseline. Baseline task and ego orientation did not differ among dropouts and club and elite players at follow-up. The results suggest an important role for growth and maturity status, functional capacities and sport-specific skills as factors in attrition, persistence and moving up in youth soccer.

Adolescence is often viewed as a critical period for selection in youth soccer. Tis analysis compared the characteristics of regionally selected and non-selected under-14 players (U-14) as a group and by position. Players were classified as local (n=69) and regional (n=45). Factorial ANOVA was used to test the effect of selection, position and respective interaction terms, while discriminant analysis was used to identify the variables that contributed to selection. Selected players were

advanced in maturity (F=24.97, p<0.01), heavier (F=30.67, p<0.01) and taller (F=35.07, p<0.01); performed better in explosive power (F=21.25, p<0.01), repeated sprints (F=20.04, p<0.01) and ball control (F=3.69, p<0.05); and were more ego oriented (F=13.29, p<0.01). The two competitive groups did not differ in agility, aerobic endurance, dribbling, shooting, passing, and task orientation. Position-related variation was negligible. The percentage of players who were correctly classified in the original groups was slightly lower when the analysis was performed for the total sample (86%) than by position (86%-90%). Future research on talent identification and selection should adopt a multidimensional approach including variables related to the physiological, perceptual, cognitive and tactical demands soccer.

Developmental changes in repeated sprint ability in young soccer players of contrasting maturity status given by the discrepancy between skeletal and chronological ages. Eighty-three youth soccer players 11-13 years at baseline were followed annually. Height, weight, repeated sprint ability, continuous 20-m shuttle endurance and counter-movement jump were measured and lean body mass (LBM) estimated. Longitudinal development changes in total sprint time were evaluated with multilevel modeling. Corresponding measurements were taken on an independent cross-sectional sample of 52 soccer players aged 11-17 years to confirm the model. Maturity status (early, on-time, late) at baseline was a significant independent predictor for height from ages 12 to 14 years and for weight and estimated LBM from 12 to 15 years. Age group, aerobic endurance, lower limb explosive strength, LBM, weight (level 1) and maturational status (level 2) significantly improved the fitness of the model. The best model for late-maturing athletes on repeated sprint ability was expressed by the following equation: 78.169 – 0.946 x age group – 0.048 x aerobic endurance – 0.093 x lower limb explosive strength – 0.216 x LBM + 0.141 x weight. Multilevel model provides performance curves that permit the prediction of individual performance across adolescence.

Toward Equality-Response Relationship in Exercise Cognition Research Across the Lifespan

Prof. Caterina Pesce

University of Rome "Foro Italico", Rome, Italy

Cognitive, coordinative or social interaction demands involved in movement and sport tasks may impact cognitive performance in the short or long term. To think beyond the framework of intensity, duration and frequency of physical activity, this presentation focuses on the non-physical demands of physical exercise involved in acute and chronic exercise and cognition research.

At present, cross-sectional chronic exercise research and sport expertise research are coming closer, especially regarding chronic exercise effects on cognitive function. In particular, the study of individual differences in cognitive efficiency deriving from chronic sport participation represents their intersection point. Further research is strongly needed to understand the interplay between physical fitness and cognitive expertise in determining cognitive benefits. Interventions centred on gross-motor cognitive training might shed some light into the engagement of cognitive and particular executive functions during physical activity for obtaining chronic exercise benefits.

Actually, few studies on the effects of qualitatively different bouts of acute exercise on cognition are available. Those few focused on the effects of single bouts of exercise whose complex movement task requirements challenge executive functions or compared the effects of acute exercise bouts of similar intensity and duration, but differing in cognitive and social interaction demands. Thus, the 'quality-response' relationship needs further research, especially considering its important practical implications during childhood and aging.

The American Prospective of Sport Participation in the Lifespan

Prof. Melinda Millard Stafford

Georgia Institute of Technology, Atlanta, USA

Over the past several decades in the United States, there has been a paradigm shift in both the philosophy and organization of sport. Following World War II and evidence that American youth were unfit compared to their European counterparts, sport became increasingly available within many sectors (e.g. religious-affiliated leagues and educational system). However, along with the decline of physical education in schools, obesity and risks for related chronic diseases are now rising across all segments of population (from child to adult). Opportunities for sport participation in American youth has instead become "highly specialized" and primarily limited to sport-specific clubs. Sport clubs are administered by their respective sport governing organization, each of which may differ dramatically in their respective requirements for coaching licensure and rules governance for the sport. No central governing body (such as the US Olympic Committee) or federal governmental agency provides support or direct oversight for sport. Numerous medical groups (American Academy of Pediatricians, American College of Sports Medicine and others) have published recommendations regarding safety in youth sport but the lack of a Ministry for Sport hampers coordinated, effective efforts. Moreover, sport is viewed primarily as important for "elite" performance development, an avenue for college scholarships- not publicly recognized for its potential role in health across the lifespan.

Policy solutions among professional scientific groups have become an effective model in the US to effect change. The American College of Sports Medicine (a global sports science and sports medicine organization) has recently placed emphasis upon a policy-based approach to increase visibility and funding for physical activity and sport. Programs such as Exercise Is Medicine™ and the National Center for Health & Safety in Youth Sports will be described along with efforts to promote re-authorization of the Physical Activity Guidelines for Americans (2008), the first-ever federal guidelines in physical activity across the lifespan.

Metabolic and Hormonal Adaptation and Disfunction in Active Diabetic Patients: From Childhood to Adulthood

Prof. Elsa Heyman

Université de Lille, Ronchin, France

It is now strongly believed that physical activity must be integrated into Type 1 Diabetes (T1D) management. However, it is often difficult to motivate patients to get involved in regular exercise. To improve effectiveness of the public health message about physical activity, factors that impede physical activity practice in T1D must be identified. Although already partially studied among adults with T1D, **perceived barriers to physical activity** remain mostly unknown in T1D children and adolescents. These barriers could be investigated through a collaboration between European researchers working in the areas of exercise sociology, psychology and physiology. In adults with T1D, fear of exercise-induced hypoglycaemia and perception of a low fitness level have been shown as two salient barriers to physical activity.

To support T1D patients through **exercise-induced hypoglycaemia** management, a promising strategy may be the individual adaptation of the modality and/or intensity of exercise due to their specific impact on counterregulatory hormones. This management of exercise-induced glycaemic variations appears all the more important that repetition of hypo- or hyper-glycaemic episodes through lifespan may have deleterious effects on cognitive function – a function that would be probably otherwise positively influenced by regular physical activity.

As **low fitness level** also represents a main perceived barrier to physical activity in T1D adults, it appears essential to identify the factors, particularly those triggered by the disease, that could be involved in the impairment of exercise adaptation and fitness.

Previous works underlined an inverse relationship between aerobic fitness (maximal oxygen uptake) and glycated haemoglobin (HbA1c), reflecting chronic hyperglycaemia. To explain this relationship, we hypothesise that the glycation of haemoglobin might increase its affinity to oxygen and thus decrease tissue oxygen availability and that chronic hyperglycaemia might alter the function of mitochondria, hence impairing tissue oxygen use. Therefore, we are carrying out experiments on the effects of high HbA1c levels on muscle and brain oxygen availability (arterial blood gazes and tissue deoxyhemoglobin variations with near-infrared spectroscopy) during exercise and on mitochondrial respiration function in skeletal muscle (biopsies).

Another intriguing topical issue possibly involved in exercise metabolic adaptation and fatigue is the endocannabinoid system, which is already known to be deregulated in other metabolic diseases like Type 2 diabetes and obesity.

We will provide an overview of the studies we performed or are carrying out, in collaboration with several other European research laboratories, on exercise-induced hypoglycaemia management and its cognitive implications as well as on biological factors influencing physical fitness in T1D patients through the lifespan. The better understanding and management of these barriers toward physical activity will help to identify potential targets for future interventions.

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Sarcopenia its Assessement and How it's Correlates with Functional Performance in the Older Individuals

Prof. Giuseppe De Vito

Univesity College Dublin, Dublin, Ireland

Aging is accompanied by a decline in all physiological functions which has an effect not only on life span but also on the capacity of an individual to maintain a meaningful, healthy and independent life. In this regard, a prominent role is exercised by the decline affecting the skeletal muscle because of its central role for mobility and functional capacity preservation. As the largest organ in the body, skeletal muscle typically accounts for ~40% of total body mass in humans, and is a major player in energy balance at rest, contributing to ~30% of the resting metabolic rate in adults. Skeletal muscle also represents a protective cushion for the elder's bones in regard to trauma and fractures.

Definition of Sarcopenia

About 30 years ago Rosenberg introduced the term sarcopenia (Greek 'sarx' or flesh + 'penia' or loss) to define this age-related decrease of muscle mass. This definition has been further elaborated in order to incorporate the presence of an associated decline in both muscle strength and physical function. This clarification is essential because it is now well accepted that the age-related deterioration in muscle function (expressed as muscle strength and power) cannot be solely explained by the low muscle mass since the decline in strength/power exceeds what is expected based on the decline in mass. This divergence between muscle mass and strength, occurring with aging, is the consequence of progressive qualitative changes of muscle fibres and tendons and alterations in the neural activation of muscles.

It is clear that one of the major issues in this context is to define universal and valid cut-off points not only to define sarcopenia but also to establish its severity a challenge complicated by the fact that now this diagnosis required the integration of muscle mass and performance parameters. It is obvious that to define a "pre-sarcopenic" status could represent a better strategy from the preventive point of view. In fact, people at risk could be identified at an earlier stage when an intervention could be more effective.

Functional consequences of Sarcopenia

Using specific thresholds for height-adjusted appendicular muscle mass to define sarcopenia, a number of studies reported a higher risk of having physical disability in sarcopenic older individuals than in those with a normal muscle mass. A recent 1 year longitudinal study conducted on older Japanese individuals suggested a positive association between yearlong physical activity (walking at an intensity >3 METs) and appendicular muscle mass (AM/ht^2).

On the other hand, other longitudinal studies showed that sarcopenia was not associated with health outcomes such as a change in mortality risk whereas both reduced hand grip and lower limb muscle strength scores were associated with higher mortality risk, despite accounting for muscle mass. Clark and Manini recently proposed to adopt the term dynapenia instead of sarcopenia to

highlight the most important role played by the reduction in muscle strength compared to that of muscle mass. Interestingly, in support of this hypothesis there are studies showing that neither testosterone supplementation (in androgen deficient individuals), nor growth hormone replacement therapy although both able to increase lean body mass were accompanied by significant changes in muscle strength.

On the other hand there is now mounting evidence indicating that the association of resistance training and proper nutritional guidance represent a valid strategy to counteract and at least partially reverse the decline in muscle mass and function in the elderly.

Research at UCD

A relevant related aspect we are investigating at University College Dublin is in relation to the role played by sarcopenia in terms of metabolic health and type 2 diabetes. We are presently conducting a research on the effects of post-exercise carbohydrate and protein supplementation on endocrine and glucose control, and muscle function in healthy volunteers and type 2 diabetes patients of age 60 – 70 years old subjected to progressive resistance exercise training. In addition, another research project we are performing is directed to investigate the relationship between muscle function, muscle mass and metabolic health in a large group (≈300) of adults aged 18-65 to explore the possibility to identify markers for early identification of people at risk to develop metabolic and/or muscle function deterioration later in life.

Exercise and the Brain in the Lifespan

Prof. Romain Meeusen

Vrije Universiteit of Brussel, Brussels, Belgium

Physical exercise influences the Brain. Through lifespan brain neurochemistry will be influenced. Brain development at young age is important not only for intellectual development, but also for motor learning. Exercise has important health enhancing effects for the brain, which last during the whole lifespan. Neurotransmitters such as dopamine, noradrenaline, and serotonine, increase during exercise. When using the microdialysis technique to monitor the extracellular concentration of neurotransmitters in different brain nuclei, it is shown that DA, NA and 5-HT release is increased during exercise, and that exercise training produces a decrease in basal neurotransmitter concentrations. Monitoring thermoregulation through registration of brain, abdominal and tail temperature and simultaneously measuring neurotransmitter release from the anterior Hypothalamus can give us insight of possible neurotransmitter-induced effects of thermoregulation during exercise.

Physical exercise can preserve cognitive function in elderly populations, promote functional recovery after Central nervous System (CNS) traumatic injury, and induce neurogenesis in the adult CNS. Physical activity also increases trophic factors production in select regions of the brain. Brain-derived neurotrophic factor (BDNF) is a crucial effector of experience-dependent plasticity. It is a neurotrophin that acts as a regulator of the survival, growth, and differentiation of neurons. Physical activity and, in particular, acute exercise and training seem to be key interventions to trigger the processes through which neurotrophins mediate energy metabolism and, in turn, neural plasticity. In search of mechanisms underlying plasticity and brain health, exercise is known to induce a cascade of molecular and cellular processes that support (brain) plasticity. BDNF could play a crucial role in these induced mechanisms. Therefore, since the early nineties, studies started to investigate the effects of physical activity, acute exercise and/or training on levels of BDNF. The first human studies examined the effects of exercise on peripheral BDNF in subjects with a neurodegenerative disease (i.e., multiple sclerosis patients) in order to explore the restorative potential of exercise in this particular disease. Several other studies on the effects of acute exercise and/or training on BDNF in humans have been carried out, of which most concern healthy subjects. We will provide an overview of the studies we performed on effect of physical activity on neurotransmission, thermoregulation and indicators of neurogenesis such as BDNF. From these papers it is clear that exercise through lifespan has the power to underscore brain health.

Sport Competitions in the Lifespan

Prof. Laura Capranica

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The lack of physical activity is a major underlying cause of disease and disability in the lifespan. Conversely, chronic participation in sport has been proposed as an ideal model to determine successful healthy lifestyles. The recent establishment of the Youth Olympic Games and the worldwide popularity of amateur and senior competitions urge the analysis of sport performances and functional profiles of athletes to avoid undue risks. In fact, considerable difference exists in situational and contextual factors in relation to the age (from pre-pubescent years to old age) and technical level (sport academy, amateur, semi-professional, and professional) of athletes. Therefore, there is a need of sport-specific as well as gender-based research on the actual requirements of different youth, amateur, and senior codes to develop strategies aimed to promote the potential of children, adults, and older athletes and to preserve them from an excessive psycho-physiological strain.

Although adequate technical supervision and psycho-social support should be provided at all age and competition levels, youth, amateur, and older individuals engaging in sport do not have technical and scientific support comparable to those of elite athletes. To provide coaches valuable insight for the development of adequate training programmes, researchers should analyze several parameters that influence performance and competitions. Therefore, a multidisciplinary approach including technical-tactical, psychological, physiological, and sociological variables is strongly needed. In particular, the examination of a wide multiplicity of movement patterns and decision-making aspects by means of notational and match analyses could be particularly effective in providing advances in the understanding of competition demands.

Finally, cross-national comparisons including social, political, economical, and organizational variables are strongly encouraged to lead global, multi-sector (i.e., government, sporting and scientific organizations, and education) efforts to provide clear lines of communication among relevant global scientific societies and Sport Governing Bodies.

Master Athletes: A Benchmark for Succesful Ageing

Prof. Maria Francesca Piacentini

University of Rome "Foro Italico", Rome, Italy

It is well known that regular physical activity provides substantial health benefits for older adults, and it is recommended as part of treatment regimens for many diseases (Kruger et al 2009). Exercise also has a major influence on brain cortical function, preventing or at least slowing cognitive decline that occurs with age (Rovio et al. 2005). In the past years citizens have become more aware of these health benefits and more competitors of all age categories are present in major road races or in swimming competitions. The number of participants in the age category 40-49 years of age at the New York City Marathon has increases by 83.54% in males and by 51% in females between the years 1983-1999 (Jokl et al. (2004). These athletes continue physical training throughout life, and are capable of remarkable athletic and physiological functional performance considering their increasing age. They strive to maintain and in some cases improve the performance they have achieved at younger age (Tanaka and Seals, 2008). Unfortunateley, there are not many longitudinal studies that evaluated the health status of former athletes that continue to train also in advanced age. Morgan and Costill (1996) reported that aging marathon runners possessed psychological characteristics similar to those reported for elite young athletes, and their health behaviour remained uniformly positive enjoying good overall health throughout their middle years. Leyk et al (2009) evaluated performance, training and lifestyle parameters of 439278 marathon finishers. They found that, despite showing the same marathon finishing time as younger athletes, the majority of middle aged athletes had a very short training history and, no matter at what age they started training, unhealthy behaviours were completely absent. Therefore, Master athletes can be considered as a benchmark for successful ageing.

Sport Competition in Later Life and its Psycho-social Influences on Aging Well.

Prof. Yvonne Harahousou

University of Thrace, Thrace, Greece

The shifting demographics of the past 50 years, have lead to an increasingly aging population in developed countries. Many older people feel isolated and participation in competitive sports provide an alternative to feelings of isolation, while keep them interested and engaged in life. Sports may also fulfil other cognitive or psycho-social needs. Older athletes perhaps present an ***ideal model for aging well***, as a result of their ability to maintain high levels of physical, cognitive & social skills. The lifespan developmental theory of selective optimization with compensation seems to apply to the competitive sports participation of older adults. Findings from a Greek study comparing senior athletes to non-athletes are also presented that reveal the important role of being an athlete versus non-athlete on aging well.

The Role of Biomechanics in Daily Sport Activities

Prof. Jan Cabri

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Biomechanics applies laws of mechanics and physics to human performance, in order to gain understanding of performance in movement events through modeling, simulation and measurement. With respect to sport, the discipline contributes to the description, explanation, and prediction of the mechanical aspects of human exercise, sport and play.

Generally speaking, applications of biomechanics can be found in:

- Improving performance in sports,
- Reducing or preventing injury during work, home, exercise, or sport tasks,
- Improving movement quality of individuals with pathologies in clinical situations,
- Assisting with the design of sport and exercise equipment, artificial limbs, occupational equipment, and training and rehabilitation devices not only to increase performance but to increase safety, also.

Biomechanical research plays an important role in sports not only in the field of performance enhancement (e.g. movement and technique analysis, development of new materials and equipment, etc.), but also provides much of what is known in the field of stress-stress hold and the pathogenesis and recovery of injuries. Furthermore, it contributes to the knowledge of biomechanical loading during the execution of sports movements.

In the last decades participation in daily sports and exercise activity has increased tremendously. Consequently, the incidence of sports and exercise related injuries increased, which resulted in a boost for medical interventions. With the risk of oversimplifying, it can be stated that many injuries are the result of a biomechanical "overuse" of the musculoskeletal system, either in an acute (trauma) or a chronic (fatigue) state. The rehabilitation of injured athletes to their functional pre-injury status is confronted with the loading capability of the injured tissue and its interaction with the known training principles (variation, overloading, specificity and recovery). Depending on the progression of the wound healing, the injured tissue may (and must) receive more and more loading in order to heal and regain functionality. Therefore, restoration of function will depend merely on the phases in which the immunological system is restoring the injured tissue. For example, in muscle injuries, it is known that these phases of repair are linked with the amount of loading the injured tissue can bear (loading capability) and that early mobilization will contribute to increased efficacy of repair. In this context, biomechanical studies contribute much to the knowledge of loading on the musculoskeletal tissues during (rehabilitation) exercises, both quantitatively and qualitatively. Additionally, biomechanical data have been proven useful to challenge current treatment concepts.

Exercise Training in Worklife for Health

Prof. Gisela Sjogaard

University of Southern Denmark, Odense, Denmark

Research in sport participation in the lifespan often focuses on children and elderly people. But the working-age population is important when considering sport participation in a life span because sports participation at old age is highly dependent on sport participation from young to mid-age. In general the largest part of our lifespan we are associated to the labor market and most people spend about half of their hours awake at the work place. To this adds that it is in particular at work that inactivity has increased in industrialized countries like in Europe and that the working population is getting older. These facts point to an increased focus on the sport and physical activity in the working population. Physically heavy work may to some extend decrease the health risks related to inactivity (14), but such workload has a number of negative side effects like various musculoskeletal disorders (5) and cardiovascular disease. A recent study in Denmark demonstrated that the risk of sickness absence increased with increased physical work load intensity by 100%; but in contrast risk of sickness absence decreased by 25% with increased leisure time physical activity. This pattern suggests to increase "leisure time like physical activity" like sports or exercise training to the working population. Since many workers have become more inactive in their jobs we suggest that the work site should offer exercise training during or in conjunction with working hours. The rationale is that the work site is the perfect area to promote exercise training. Not only can massages be conveyed on the health benefits of sports and physical exercise training but also can specific programs and facilities be introduced and exercises can be performed in a social context. Among others football is demonstrated to have immense health effects.

We have conducted several interventions in terms of randomized controlled trials foremost among workers with repetitive monotonous work and more recently also among those with physically heavy work like cleaners, health care workers and construction workers. In these studies physical exercise training for 1 hour per week was performed by workers during working hours and significant health effects were demonstrated. The specific training offered was tailored to the job group and to the individual based on their health profile and physical functioning. Research is lacking to further optimize these training programs and to include in their development the motivational factor. This is a young research area which has increased tremendously the last decade evidenced by systematic reviews published already but further evidence is requested.

Novel observations point towards cultural changes at the labor market with increased acceptance of health enhancing initiatives to be introduced at the worksite. These include physical exercises or sport activities. Future studies should pay special attention to vulnerable groups of e.g. young parents with small children or the aging workers. Leisure time sport activities for these groups are often limited due to lack of time or impaired health conditions. Cross-national studies with interdisciplinary approaches are lacking to reveal successful actions at the work site to increase sport participation in these groups. Motivation and accessibility to various sports activities must be kept high among the working age population if long life sports participation in the elderly is envisaged.

The Role of Muscular Function in the Lifespan Activities

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Physical activity patterns are prone to change during aging. This usually means that physical activities include less and less strenuous, strong and fast muscle contractions. Therefore, when interpreting data from aging population, it is difficult to identify the changes in e.g. motor control and muscular function that are purely influenced by the aging process. Several experiments have shown that the function of the neuromuscular system changes during ageing, particularly after the 6th decade of life (Häkkinen & Häkkinen, 1991). This is characterized by a reduction in muscle strength and a loss of fast motor units (Doherty et al. 1993). In addition, changes may occur in the central nervous system, control strategies and reflex loop activity. It has been shown in numerous experiments that these degenerations can lead to serious problems in motor control of elderly people, including decreased balance control and increased risk of falling (e.g. Kannus & Parkkari 2006). Falling accidents usually occur in dynamic situations, which are more complicated for the entire neuromuscular system. Therefore, possible differences in balance control and in the corresponding mechanisms between young and elderly people should be investigated in conditions where the individual tries to regain balance after a dynamic standing perturbation. Our preliminary experiments with a custom made balance measuring system have shown that the sensitivity of a Hoffman-reflex (H-reflex) when measured at different time points after a sudden perturbation differs significantly between young and elderly people, suggesting that there are differences in the spinal control mechanisms between these age groups. It is well known that resistance training can lead to improved force production capabilities, and in some cases more stabilized balance control, especially when measured during static conditions. There is also some evidence that the changes in H-reflex modulation can be preserved with more intensive physical activities in elderly people (Hämäläinen & Avela, 2003). Therefore, maintenance of physical activities, which include also strenuous, strong and fast muscular contractions, throughout the lifespan is extremely important for healthy motor control and, thus muscular function.