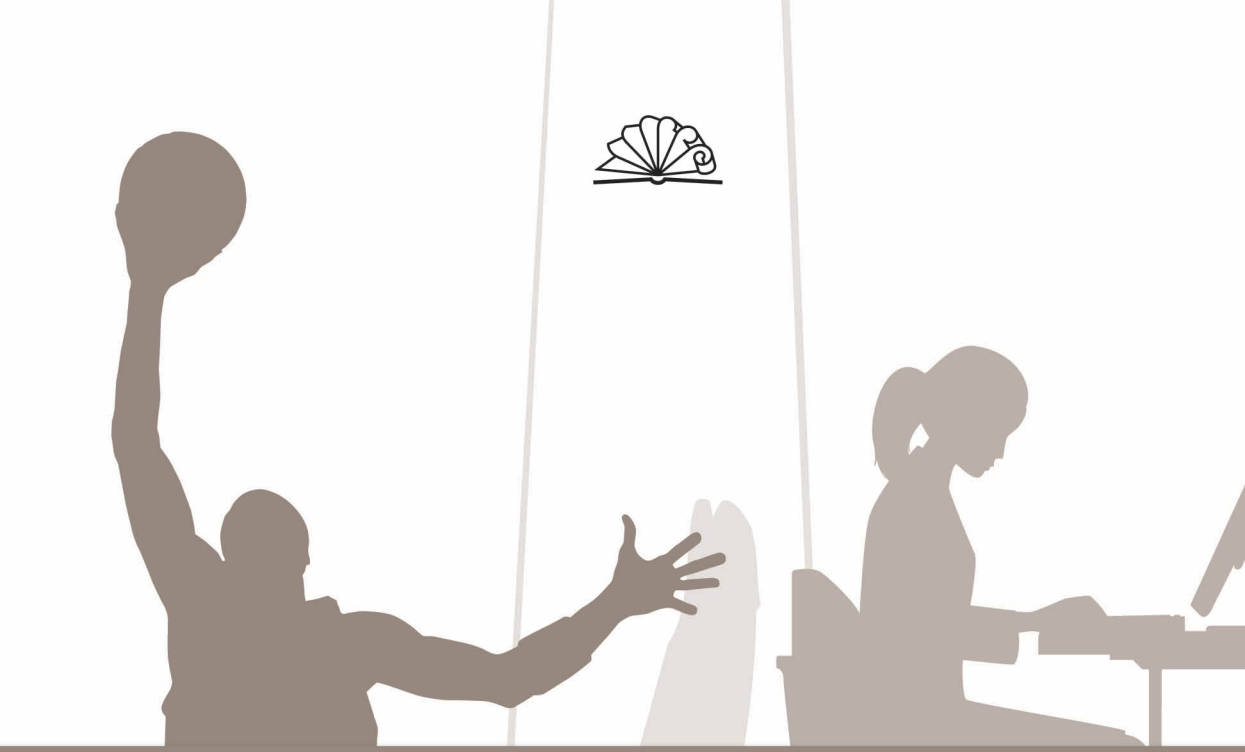

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Journal secretary contact / ***Sedež:*** Annales Kinesiologiae, University of Primorska, Science and Research Centre,

Garibaldijeva 1, SI-6000 Koper – Capodistria
tel.: +386 5 663-77-00; fax: +386 5 663-77-10

E-mail: annales.kinesiologiae@zrs.upr.si

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TABLE OF CONTENTS

REPORTS AND REVIEWS
POROČILA IN OCENE

EDITORIAL

In cooperation with various experts as well asmany professional fields and disciplines, we have been searching for answers to questions concerning convincing modern generations of children, adolescents and adults that not only is movement and sports activity necessary and important for their holistic development, performance and health, but also that being active is their duty and responsibility to future generations.

We are currently witnessing a number of discoveries, new truths and conclusions which are the result of the harmfulness of physical inactivity as well as the role and importance of adequate, personalized exercise and training for preventive, rehabilitation and curative needs as well as for achieving the targets of a competitive athlete. As the science of human movement, kinesiology is thus faced with finding new ways to ensure the quality of physical competence of an individual. The triangular relationship − *man* − *environment* − *task* kinesiology is trying, with its own resources and tools, to offer new options for a balance, compensation or excellent results. The model has three main points: *a man* (from children to the elderly), the *environment* (both physical and social) and *a task* (the basic functionality or upgrade are equivalent for determining the selection of *resources and tools* − suitable content for exercise or sports activities).

The incentives for movement during all stages of life, from childhood to adolescence andthrough young adults to an active period and then old age are the best investment in both current and future generations. Physical exercise / sports activity is becoming a synonym for health and thus, the path to equilibrium towards which we strive. It is crucial that every individual has their own specific needs or problems and their own balance. The offer of physical activity should be adapted to each individual and should be rich both in quantity and quality taking place in an environment that is the most convenient for each participant.

The contributors of the articles collected in the following Annales Kinesiologiae journal offer interesting approaches to the treatment of children and the elderly through different topics. They also provide new knowledge concerning the abilities and barriers in an individual's performance in extreme environmental conditions and they address the role of exercise and training as a lever to achieving our day-to-day objectives, motor learning, as well as identification in elite sports. Different views, different cultural, social and geographical environments, one scientific treatment, one integrative science − kinesiology.

Professor Rado Pišot, Ph.D.,
Editor-in-Chief

UVODNIK

Odgovore na vprašanja, kako prepričati sodobne generacije otrok, mladostnikov in odraslih, ne le da je gibalna/športna aktivnost nujno potrebna in pomembna za njihov celostni razvoj, funkcionalnost in zdravje, temveč da je biti aktiven tudi njihova dolžnost in odgovornost do prihajajočih generacij, iščemo že vrsto let v krogu različnih strokovnjakov, strokovnih področij in znanstvenih disciplin.

Priče smo številnim dognanjem, novim resnicam in ugotovitvam tako o škodljivosti gibalne neaktivnosti kot o vlogi in pomenu ustrezne, posamezniku prilagojene vadbe in treninga za potrebe preventive, rehabilitacije in kurative kot tudi za doseganje tekmovalnih ciljev športnika. Kineziologija kot znanost o gibanju človeka se tako spopada z iskanjem poti za novo kakovost gibalne kompetence posameznika. V triangularnem odnosu *človek-okolje-naloga* poskuša s sebi lastnimi sredstvi in orodji ponuditi nove možnosti za vzpostavljanje ravnovesja, kompenzacije ali vrhunskega rezultata. Vsa tri temeljna izhodišča modela *človek* – od otroka do starostnika, *okolje* – tako fizično kot socialno in *naloga* – osnovna funkcionalnost ali nadgradnja enakovredno določajo izbor *sredstev in orodij* – primernih vsebin gibalne/športne aktivnosti

Gibalne spodbude tekom vseh življenjskih obdobij od otroštva, adolescence in mladostništva do aktivnega obdobja in starosti so najboljša naložba v sedanje in prihajajoče generacije. Gibalna/športna aktivnost tako postaja sinonim za zdravje in s tem pot do ravnovesja, h kateremu stremimo. Vedeti pa moramo, da ima sleherni posameznik svoje specifične potrebe ali probleme in svoje ravnovesje. Njemu mora biti prilagojena količinsko in kakovostno bogata ponudba gibalne aktivnosti, ki se hkrati odvija v zanj najprimernejše usmerjenem okolju.

Avtorji prispevkov, ki jih zaokrožuje sledeča revija Annales Kinesiologiae, nam ponujajo zanimiva izhodišča, ki v obravnavo umeščajo otroka in starostnika, ponujajo nova vedenja o zmožnostih in ovirah delovanja posameznika v ekstremnih okoljskih pogojih ter obravnavajo vlogo vadbe in treninga kot vzvoda doseganja vsakodnevnih življenjskih ciljev, gibalnega učenja kot tudi identifikacije v vrhunskem športu. Različni pogledi, različna kulturna, socialna in geografska okolja, ena znanstvena obravnava, ena integrativna znanost – kineziologija.

Prof. dr. Rado Pišot,
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MORPHOLOGICAL AND FUNCTIONAL MODIFICATIONS DURING THE PROCESS OF AGEING: CHARACTERISTICS AND BENEFITS OF PHYSICAL ACTIVITY

Paola VAGO, Nicola LOVECCHIO

Catholic University of Sacred Heart of Milan, Department of Pedagogy
Largo Gemelli, 1, 20123 Milano, Italy

Corresponding author:
Paola VAGO
Catholic University of Sacred Heart of Milan, Department of Pedagogy
Largo Gemelli, 1, 20123 Milano, Italy
paola.vago@unicatt.it, nicola.lovecchio@unicatt.it

ABSTRACT

Ageing is a slow but dynamic process, which involves many internal and external influences. It is a complex multifactorial phenomenon characterized by progressive physiological, genetic, endocrinological and molecular changes, responsible for the increased risk of morbidity and death.

Because of an increase in life expectancy, the incidence of degenerative diseases, such as muscular and skeletal diseases will also increase.

The age-associated loss of skeletal muscle mass and strength (i.e. sarcopenia) seems to be an unavoidable part of the physical human decline. In fact, the relationship of ageing with impaired physical performance, frailty, loss of functional independence and increased risks of falls are well established in the literature. In addition, decreased muscle strength is also highly predictive of incident disability in the elderly. In particular, weakness and functional deficit have been considered hallmark predictors of age related morbidity and decreased autonomy. Research on ageing has traditionally been concerned with health, but recently the concept of functional capacity has also been attracting growing attention. Regular physical activity, including, muscle-strengthening activity such as resistance exercises, balance and flexibility exercises, aerobic activity, is essential to develop a strategy to delay ageing.

Keywords*: ageing, functional impairment, elderly, physical activity, functional ability, health*

MORFOLOŠKE IN FUNKCIONALNE SPREMEMBE V PROCESU STARANJA: ZNAČILNOSTI IN PREDNOSTI TELESNE AKTIVNOSTI

POVZETEK

Staranje je počasen, ampak dinamičen proces s številnimi notranjimi in zunanjimi vplivi. Je obenem kompleksen in večstranski pojav, ki ga označujejo progresivne fiziološke, genske, endokrinološke in molekularne spremembe, ki so razlog za povečano tveganje obolevnosti in smrti.

Zaradi zvišanja pričakovane življenjske dobe se ravno tako poveča tudi pojavnost degenerativnih bolezni, kot so bolezni mišic in skeleta.

Zdi se, da je s starostjo povezana izguba skeletne mišične mase in moči (tj. sarkopenija) neizogibni del fizičnega upada pri človeku. Opisi razmerja med staranjem in slabšo telesno uspešnostjo, krhkostjo, izgubo funkcionalne neodvisnosti in povečanim tveganjem za padce so dejansko dobro zastopani v literaturi. Poleg tega pa zmanjšana mišična moč zelo dobro napoveduje pojav invalidnosti pri starejših. Zlasti šibkost in upad funkcionalnosti se upoštevata kot znamenji s starostjo povezane obolevnosti in zmanjšane samostojnosti. Raziskave staranja so se tradicionalno ukvarjale z zdravjem, vendar se v zadnjem času vedno bolj osredotočajo na pojem funkcionalne sposobnosti. Redna telesna aktivnost vključno z dejavnostmi krepitve mišic, kot so vaje za moč, ravnotežje in gibkost ter aerobne aktivnosti, so bistvenega pomena za razvoj strategije za zaviranje staranja.

Ključne besede*: staranje, funkcionalne okvare, starejši, telesna aktivnost, funkcionalna sposobnost, zdravje*

INTRODUCTION

Manifestations of ageing appear in all body systems and tissues, the ones in the neuromuscular system have an essential role as they have a direct impact on mobility and physical independence. Indeed, Gersten (1991) reported that muscular strength decreases significatively beyond forty years of age and at the age of seventy-four 28 % of men and 66 % of women are unable to handle an object weighting more than 4.5 kg. With ageing, muscles become weaker for many reasons. First, muscle fibre size decreases which results in a reduction of the cross-sectional area. Second, the number of fast muscle fibres decreases which itself causes a strength loss. In addition, there is evidence that the ability to activate motor units reduces itself with age, so that even the fibres that remain in the muscle are not used (Lieber, 1992).

Muscle modifications consist of atrophy decreased II type fibre diameter, a disruption of sarcomere structure and an increased percentage of intramuscular connective tissue and intermuscular adipose tissue.

During ageing, there is a true muscle remodelling. Some authors (Longo et al.; Vago et al., 2014) have seen that ageing changes both the length of muscle fibre fascicles and the angle of pennation.

Thom et al. (2007) have analyzed the changes in muscle in elderly people (aged from 69 to 82) and also in younger men (aged from 19 to 35). The analysis showed that there is a decrease in fascicle length, which leads to a loss of sarcomeres in series, which implies a loss of muscle shortening velocity, as a decrease in pennation angle reflects a loss of sarcomeres in parallel, therefore, in muscle cross sectional area and in muscle force.

The remodeling of muscles occurs due to atrophy. Occasionally, as seen before, with atrophy the muscle tissue is lost, the packing of contractile tissue along the tendon aponeuroses decrease. (Narici & Maffulli, 2010).

The reduction of sarcomeres in parallel (decrement in pennation angle and muscle cross sectional area) and in series (decrease in length fascicle) is due to the decrease in protein synthesis that occurs with ageing and disuse.

The age-related loss of muscle mass, affects > 50 % of the population aged seventy-five and over and is the main cause of impaired physical performance and reduced mobility. Amongst several factors contributing to loss of muscle mass, neuroendocrine changes are regarded as primary drivers of this condition (Narici & Maffulli, 2010) and are responsible for alpha-motor neurons and neuromuscular junction degeneration, since muscle fibre denervation, also fuelled by mitochondrial dysfunction and oxidative damage, leads to the loss of motor units and muscle weakness. One of the major functional characteristics of ageing is the disproportionate loss of muscle strength: at the age of eighty the loss of muscle strength is about four-fold greater than that of muscle size. This intrinsic muscle weakness, also known as deterioration in 'muscle quality', has traditionally been reconducted to a decrease in fibre specific tension, reduced excitation-contraction coupling and reduced neural drive. However, new evidence suggests that this disproportionate loss of force also arises from changes in the extracellular matrix and of associated proteins, leading to a decrease in lateral force transmission (Zhang & Gao, 2014) which in young muscle normally contributes to > 50 % of muscle force output (Huijing, 1998).

Age-related atrophy is often paralleled with increases in inflammation, metabolic syndrome, arterial stiffness and glucose intolerance (Ershler & Keller, 2000).

Muscular changes also affect the respiratory system as shown by alterations in inspiratory and expiratory volumes and pressures. In addition, the cardiovascular system (fundamental for independence) undergoes age-related changes associated with ageing. Since 1938, when Robinson Sid first reported a reduction of VO_{2max} (maximal oxygen uptake) with ageing, numerous studies have addressed the impact of ageing on cardiorespiratory function. For example, vigorous exercise may increase longevity while a moderate physical activity may improve cardiac function in octogenarian individuals

(Shepard, 1994). Fleg et al. (2005) reported that age contributes to the decline in performance and that a decrease in physical activity and muscle mass worsens the process. They also showed that VO_{2max} drastically declines with advancing age, as a result of a decrease in maximal heart rate, stroke volume and oxygen extraction by working muscles. Untrained men and women reach their highest aerobic capacity at the age of approximately twenty-five, women's aerobic capacity being about 20 per cent below men's. While growing older, men lose about 10 per cent of their aerobic capacity per decade, whilst women lose approximately 7 per cent. Therefore, at around seventy-five years of age, the gender difference in aerobic capacity is almost nullified (Wieser & Haber, 2007).

The ageing process is also characterized by difficulties in ensuring balance control, especially in the condition of reduced or conflicting sensory information, leading to an increased risk of falling. The balance modifications can alter the gait action: shorter stride length and increased double support time are often observed in elderly people. For many of them, ageing process adversely affects balance control resulting in a restriction in their ability to move independently, to maintain various positions or to react to external disturbances, such as a moving bus or to walk on an uneven surface or in shadowy light (Buatois et al., 2007).

THEORETICAL APPROACHES, MAIN QUESTIONS AND METHODS

Years ago, Heikkinen (1998) observed that as the musculoskeletal system deteriorates in old age, increasing mobility problems. An elderly person's range of movement is seriously decreased with inactivity or a sedentary lifestyle. Decreasing mobility and the age-related decline in balance lead to a decrease in gait skills, gait speed and cause more falls. Indeed, most causes of fall-related injuries in elderly are correlated to falls on stairs (normally an automatic skill). Mian et al. (2007), in a study conducted on 34 adults (69–82 years old) and 23 young adults (20–29 years old), all capable of descending stairs, observed that the deficit of physiological age-related functions can produce a negative effect in descending stairs. Moreover, an increasing body of evidence has been suggesting gait speed as a possible important vital sign in older people. Gait speed has been associated with clinical (e.g. comorbidities) as well as subclinical conditions (e.g. atherosclerosis or inflammatory status) and is able to predict several health- related events and even unrelated events to physical function (e.g. cognitive impairment, hospitalization, institutionalization). Gait speed may thus serve as a marker of physiological reserve and potentially it could quantify an overall health status. In other words, gait speed may represent the key-screening instrument to distinguish older (i.e. chronologically aged) from geriatric (i.e. biologically aged) patients and drive the subsequent clinical decision (Cesari, 2012).

Sedentariness, fatigue, poor muscle strength and slow and usual gait speed pose the old person in a state of increased vulnerability with high risk of major negative health-related events, including disability.

Therefore, a crucial role of physical activity becomes evident if these conditions are taken into account: all daily activities are affected. Indeed, the degree of effort depends on maintenance of sufficient aerobic capacity and the strength to deal with daily activities even if the elderly need, also, support in occupational adaptation process and in fluctuating day-to-day abilities using holistic strategies and client-centred interventions (Norberg et al., 2014).

Physical activity preserves the functional capability above that of sedentary individuals. Indeed, it can be concluded that movement could have a positive impact on all body functions, because this is both primary and secondary prevention. Warburton et al. (2006) reported that being fit or active was associated with a 50 % reduction in premature death. Besides, an increase of energy expenditure leads to a decrease of almost 20 % of cardiovascular deaths, with increased longevity (Lee & Paffberger, 2000). The regular physical activity increases cardiovascular efficiency, reduces hypertension and thromboembolic stroke and has a substantial therapeutic role in coronary heart disease as well as peripheral vascular disease (Nelson et al., 2007). In particular, regular low physical activity intensity (< 3 METs) that uses large muscle groups could attenuate or reverse the disease process in patients with cardiovascular disease, considering peripherals adjustments like increased capilarization (Pollok et al., 1998).

Age-related decline in insulin sensitivity appears progressively, which significantly contributes to the increased incidence of type 2 diabetes mellitus in older people. Aerobic and resistance activity (at least walking for 2 hours per week) should have benefits on glycaemic control and should also decrease the incidence of premature death for cardiovascular cause ─ related with diabetes (Warburton et al., 2006). Other investigations confirmed that aerobic exercise (with 500 Kcal in energy expenditure per week) decrease the incidence (6 %) of diabetes in high risk people and adding life-style modifications (in 3 to 4 years) as people could reduce the risk for between 40 % and 60 %.

A life-style based on a correctly carried out and controlled systematic training could, in advance, support people to manifest low level of depressive symptoms especially when the body mass index is in a norm weight range (Dugan et al., 2014). Indeed, the High Intensity Training (based on 15 minutes of exercise) could reduce the cardio metabolic disease risk (Kessler et al., 2012), the metabolic syndrome (Tjønna et al., 2008) and increase the insulin sensitivity (Gibala et al., 2012).

RESULTS OF THE APPROACHES IN AVAILABLE STUDIES

In an interesting review on cancer and its correlation with physical activity, there is evidence of a decrease in the incidence of colon (from 30 to 40 %) and breast cancer (from 20 to 30 %) in active people. (Warburton et al., 2006) while after the diagnosis

it becomes important to follow the guidelines for physical activity with encouragement: unprepared or less disposed categories of people, often, need motivational support (Hair et al., 2014).

Regular physical activity and weight loss can improve the risk factors that contribute to heart disease in women. Exercise of sufficient quality and quantity improves blood lipids, reduces insulin resistance, and promotes weight loss or weight maintenance, and attenuate abdominal fat gains in premenopausal and postmenopausal women (Mosca et al., 2007).

In women, ageing and the endocrine/neuroendocrine changes induced by menopausal transition, are at the basis of the many signals that occur together with the onset of many of the climacteric symptoms. The lack of oestrogens amplifies the progression of all age-related decaying processes and definitively induces the so called "frailty syndrome" of older age. This syndrome is the combination of the hypo function of many homeostatic systems and organs such as the metabolic system, the cardiovascular system, the endocrine and neuroendocrine systems and the central nervous system. The results of this is a perfect mixture of subnormal functions that induces a specific decay of many biological and vital functions, exposing the human being to a lot of potential risks such as cardiovascular risks, depression, anxiety, cognitive problems and more. Women in menopause, with hormonal disequilibrium, have a high probability of osteopenia/osteoporosis with low bone resistance and more probability of fractures. A regular activity that stresses body districts with external load prevents waste in body density (Carter et al., 2001) but a stress in all districts is necessary because its benefits affect only the involved areas.

Controversial evidence exists regarding the relations between physical exercise and mental health. Baldwin, R. C. (2010) suggested that moderate regular physical activity is necessary to prevent depression in later life. Elderly people with low mental health must be encouraged to keep up as much activity and exercise as possible, perhaps resorting to a short `programme` to encourage structure and purpose. A recent and fascinating report shows how physical activity in older adults changes the structure and functional capabilities of the brain and, conversely, the mechanisms by which the brain integrates metabolic, cardiovascular and behavioural responses to exercise (Benedict et al., 2013). Moreover, *brain-derived neurotrophic factor* (BDNF) plays a key-role as a mediator of the effects of exercise on the brain, regulating metabolic and cardiovascular responses to exercise (Mattson, 2012). At the same time, another fundamental role of physical exercise consists in the prevention and reduction of depression, stress, muscle tensions and anxiety, increasing self-esteem and feeling of life gratification (Dunn et al., 2005).

Ferris et al. (2005) reports also the benefits of 6 months of resistance exercise on sleep quality. Insomnia has notable consequences, the crucial point is the compromising of functions during the vigil times. Sleep disorders that are very common in the population, such as chronic insomnia, restless legs syndrome, obstructive apnoea may promote ageing, are co-factors of many age-related diseases. Sleep disturbances that characterize the aging process would also be an important co-factor of cognitive disor-

ders of various degrees, of immunosenescence and inflammaging. Sleep disorders promote ageing and age-related diseases generate a global psyconeuroendocrineimmune imbalancement. Inflammaging or low-grade chronic inflammation is one of the main players of this imbalancement that binds sleep disorders to ageing process. (Polimeni, 2012). Oxidative gets damaged with ageing, which further invokes an inflammatory response, it may be another mechanism leading to an increase in the level of inflammatory cytokines. The physiological alteration of sleep architecture that characterizes ageing process and age-related sleep disorders are considered an important pathogenic factor of inflammaging. The exact mechanism for the increase of inflammatory cytokines with age has not been fully understood. Some proposed mechanisms include the known increase in total and visceral adiposity with age (fat mass produces about 15 %–30 % of Interleukin-6), the declining levels of sex hormones, disnutrition, subclinical chronic infection, chronic stress, chronic pain disease and physical inactivity (Polimeni, A., 2012).

Reducing the secretion of inflammatory cascade in elderly, by administration of sex steroids, decreasing fat through diet and specific exercise, improving night-time sleep, and controlling adequately chronic pain and inflammation, may improve sleep, daytime alertness and performance and decrease of the risk of common old-age ailments, e.g. metabolic and cardiovascular problems, cognitive disorders and osteoporosis. Thus, improvements in sleep quality are related to life quality.

Furthermore, mobility is crucial to maintain independence. Activity focused on muscular flexibility and articular mobility could help subjects to preserve their range of movement.

Regarding these aspects, many third-age physical activity programmes are proposed. Typically, most training protocols focus on improving limb and abdominal muscle strength but gait is the most important function to preserve in order to maintain independence in old persons. The positive effects are often underestimated and relegated only to psychological and social aspects while also in a homely protocol after 8 weeks of training (2 times per week, 1 hour each) physical improvements were evident (Merati et al., 2011). For example, the score obtained in Tinetti Test (1986) increased (at least for 1 point) with reductions in variability while in Chair Stand Test (Jones et al., 2000; Jones & Rikli, 2002, Rikli & Jones, 2007) all people increased their performance between 1 and 5 complete movements (Lovecchio et al., 2010). Also, during ‘8 Foot Up and Go Test’ (the measurement of speed gait and balance during changing direction, Jones & Rikli, 2000; Rikli & Jones, 2007) the performance time decreased, on average, till 1.7 sec (Lovecchio et al., 2010).

So, the stand-up capacity (strength), the capacity of stand up and walking with a change of direction (strength and balance), and gait capacity (balance) are easily improved during the course.

Other authors found positive results (Persch et al., 2009; Rogers et al., 2003; Rose et al., 2002) even with different scores. Within these differences there were no reports of negative training-related effects and suggested that muscle strength training (not isometric contraction) is the best way to improve both walking action and balance. From

a general point of view, Hunter et al. (2001) found, after six months of training (three sessions per week), low level of fatigue during carrying a load.

An interesting study published on Medicine and Science Sports Exercise (2011), has proved that strength training (e.g. resistance training) is effective for eliciting gains in lean body mass among older adults, particularly with higher volume programmes. Results suggest that resistance exercise participation earlier in life may provide superior effectiveness. (Peterson & Sen, 2011)

Thus, regular physical activity helps the elderly to maintain independence (the most important aim) and physiological function for a long-term period through a holistic training programme, focused on muscular strength, bone density, neuromuscular coordination, postural stability and gait performance (American College of Sports Medicine position stand, 2009).

CONCLUSIONS AND PERSPECTIVES

According to the reports from the World Health Organization (WHO, 2003), a systematic physical activity can be highly recommended in the elderly and the derived benefits are extensive. There is substantial evidence that regular activity reduces risk of injuries from falls, prevents or mitigates functional limitations and is an effective therapy for many chronic diseases. Physical activity prevents or delays cognitive impairment and helps to manage depression and anxiety disorders.

Physical activity and exercise should meet the real individual's need. The plan of intervention, preferably in consultation with a health care provider or fitness professional, should be tailored according to individual's ability or limitations, strategies for increasing activity gradually over time (for non-active older adults), behavioural strategies for adhering to regular physical activity.

A systematic resistance training could be very effective, it leads to a genuine increase in muscle mass and muscle strength in healthy old men and women beyond seventy years of age (Wieser & Haber, 2007). At this age, the pure muscle training can significantly increase the maximum oxygen uptake, due to an augmentation in muscle mass (fat free body mass).

Volume of training and age of participation are important determinants of effectiveness, suggesting that higher dosage results in greater adaptive-response, and that ageing individuals should consider starting a regimen of resistance exercise as early as possible, to optimize results. (Peterson et al., 2011).

Any improvements could help to motivate people to persist with physical activity behaviour change. This is important because increasing physical activity in middle-aged and young-old adults may help increase independence, improve health and reduce disability in later years.

Older people may need to be persuaded that age is no obstacle and that with regular exercise they will enjoy physical independence and interaction with others.

In conclusion, there is evidence that improvements in an upcoming field of science named 'bio gerontology' and the scientific understanding of ageing has made huge advances in recent years. One of the most important findings in *biogerontology* is that there are no specific genes for ageing, known as gerontogenes, and ageing is not controlled by a single mechanism. A promising and powerful approach is that of mild stress such as the well- documented beneficial effect of moderate exercise, which initially increases the production of free radicals, acid and aldehydes. The response to the stressor defends the organism against not only that particular stress, but also it overshoots, facilitates the removal of other molecular damages in cells and tissues. Mild stresses that have been reported to delay ageing and prolong longevity in cells and animals include temperature shock, irradiation, heavy metals, pro oxidants, alcohol, acetaldehyde, hyper gravity, mechanical stretching exercise and food restriction. (Rattan, 2012).

Future perspectives for the global management of age-related disorders predict that structural and functional genomics and proteomics may help to search for reliable biomarkers to personalize therapeutic treatment. Pharmacogenomics and nutrigenomics are attractive anti-ageing options for predicting or minimizing drug interactions, increasing drug efficacy and reducing unnecessary costs, however, physical activity remains an important way, which can be used for both maintaining health and youthfulness and extendingthe health-span of longevity.

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THE EFFECTS OF ACUTE PHYSICAL EXERCISE TRAINING ON MATHEMATICAL COMPUTATION IN CHILDREN

Gustav BALA
University of Novi Sad, Faculty of Sport and Physical Education,
Lovćenska 16, 21000 Novi Sad, Serbia
e-mail: gustavbala@yahoo.com

ABSTRACT

The aim of this study was to determine whether acute physical exercise may increase the ability of young children to quickly solve basic mathematical problems. The participants who took the basic mathematics test before and after physical exercise included 288 preschool children, 128 children from school institutions, and 13 from a special needs school (mildly mentally disabled children, ages 13-14). The participants who took the basic mathematics test without employing physical exercise included 18 children from pre-school and 67 from school institutions.

The results showed that the children's computation performance was enhanced significantly in the groups with 30, or 45, or 60 min of physical exercise, but not in the groups without physical exercise. This means that even acute intensive physical training can yield positive effects on children's mathematical abilities.

Keywords: *computation performance in children, cognitive abilities, physical exercise, neural networks*

UČINKI ENKRATNE TELESNE VADBE NA MATEMATIČNO RAČUNANJE PRI OTROCIH

POVZETEK

Cilj pričujoče raziskave je bil ugotoviti, ali lahko enkratna telesna vadba pri mlajših otrocih poveča sposobnost hitrega reševanja osnovnih matematičnih operacij. V raziskavo je bilo vključenih 288 otrok iz predšolskih ustanov, 128 šolarjev in 13 otrok iz šole s prilagojenim programom (rahlo duševno zaostali otroci v starosti 13 ali 14 let), vsi pa so se preizkusili v reševanju osnovnih matematičnih operacij pred in po telesni vadbi. 18 otrok iz predšolskih ustanov in 67 šolarjev pa se je v osnovnih matematičnih operacijah preizkušalo v obdobju brez vmesne telovadbe.

Raziskava je pokazala, da so bili pri računanju veliko uspešnejši v skupinah, ki so imele vmes 30, 45, ali 60 minut telesne vadbe, in slabši v skupinah, kjer vmes niso telovadili. To pomeni, da lahko tudi enkratna intenzivna fizična vadba prinese pozitivne učinke na računske sposobnosti otrok.

Ključne besede: *uspešnost otrok pri računanju, kognitivne sposobnosti, telovadba, nevronske mreže*

INTRODUCTION

The tendency in the current school system, and in society in general, is to put more emphasis on the development of children`s cognitive functioning than on the proper motor activity, thereby largely ignoring its importance in children's development and not only from a biological point of view. Increasingly we hear suggestions concerning the need to abolish physical education in primary and secondary schools because, allegedly, this time can be better spent teaching other subjects, mathematics, physics and the like. Furthermore, despite the position of kinesiological experts to introduce a minimum of three hours of physical education a week, it is clear that the state institutions do not look favorably upon this proposal, despite the fact that there is plenty of evidence indicating the positive impact of motor activity, not only on one's biological development and health status, but also on mental development and the whole range of cognitive and conative dimensions of personality.

Gabbard and Barton (1979) assessed the mathematical computation performance of 106 6th-grade boys and girls before and immediately following 20, 30, 40, and 50 min of vigorous physical activity. Contrary to the researcher's predictions, the children's computation performance was enhanced significantly following 50 min of exercise.

Kawashima (2008) found in his research that simple calculations activated the brain more effectively than any other activity. He also discovered that the best way to activate

the largest regions of the brain was to solve these calculations quickly. That is why he created the easy-to-solve problems.

The aim of this study was to determine whether acute physical exercise may increase the ability of young children to quickly solve basic mathematical problems. Since the previous research on young children from the same geographical area, which had a similar socio-economic status, found that there was no statistically significant differences in cognitive abilities between boys and girls aged 4 to 10 years (Fajgelj, Bala, & Tubić, 2007), the analysis was carried out in each subsample for boys and girls together.

METHODS

The participants who took the basic mathematics test before and after physical exercise included 288 preschool children (ages 5 to 6), 128 children from school institutions (ages 7 to 8), and 13 from a special needs school (mildly mentally disabled children, ages 13 to 14). The participants who took the basic mathematics test without employing physical exercise included 18 children from pre-school (ages 5 to 6) and 67 from school institutions (ages 7 to 9).

The type of institution (Group), the number of children in groups (N), and the school activities (Mode) are listed in the appropriate columns of Tables 1 and 2.

The test used to assess the success of solving basic mathematical operations consisted of 40 tasks with the operations of addition and subtraction (the same difficulty level for pre-school children and school attending children), and multiplication and divisions (the same difficulty level for school age). Each task only employed 2 members, the corresponding mathematical operation symbol and an equal sign (eg., 3 + 5 =, 10 – 7 =, 2 x 3 =, 6 : 2 =), and the respondents were asked to solve and write down the solution for each task as soon as possible, taking 2 minutes at the most. The test result was graded according to the number of correct answers.

Each group of children provided the consent of both children's parents and teachers to take the test. The same test with 40 tasks, with briefinstructions was applied in all subsamples of children tested prior to the class activities. Each child received a single sheet of printed tasks and an eraser pencil. In case of an incorrect response the child was able to erase the answer or cross it out and then enter another result. Children from each group started the test at the same time. After 2 minutes the examiner stopped the testing and collected all the tests. Afterwards, the teacher began the implementation of the relevant class activities. At the end of the lesson the children were given the same mathematical tasks. After 2 minutes the testing was finished. All testing and procedures were performed in accordance with the ethical standards laid down in the Declaration of Helsinki.

For each subsample of children the basic statistics were calculated (mean − M, standard deviation − SD, standard error of the mean − SEM, minimum − MIN and

maximum − MAX score in the test) for the test scores before and after the individual class activity. The significance of differences between the test results before and after the class activity (p) was analyzed using a nonparametric technique of Wilcoxon Sign Test and Signed Test, but also a parametric technique Paired-samples t test (t). Since all techniques gave synonymous results, only the result of the last analysis technique was shown.

RESULTS

The results showed that children's computation performance was enhanced significantly in the groups with 30, or 45, or 60 min of physical exercise (Table 1). The calculated standard errors of means (SEM) can be applied in assessing the range of possible results of the means in the case before and after the application of the appropriate types of activities in class at pre-school children and school attending children for the population from which small samples of respondents were drawn.

Table 1: Differences in the successful solving of elementary mathematical problems before and after physical exercise.

Group	Mode	N	MIN	MAX	M	SD	SEM	t	p
Sp. school Preschool Novi Sad	Before physical exercise	47	0	40	12.1	14.1	2.1	-4.96	0.01
	After 60 min physical exercise	47	0	40	14.9	14.9	2.2		
Pre-school Novi Sad Novo Naselje	Before physical exercise	121	0	28	4.1	4.6	0.4	-6.94	0.01
	After 30 min physical exercise	121	0	34	5.8	6.1	0.5		
Pre-school Novi Sad	Before physical exercise	24	0	17	4.5	3.3	0.6	-4.29	0.01
	After 30 min physical exercise	24	1	23	6.5	5.0	1.0		
Pre-school Subotica	Before physical exercise	96	0	40	15.1	13.6	1.4	-5.84	0.01
	After 30 min physical exercise	96	0	40	17.6	14.4	1.4		
Sp. school School Novi Sad	Before physical exercise	26	2	40	19.6	10.2	2.0	-4.06	0.01
	After 60 min physical exercise	26	2	40	22.1	10.2	2.0		

School 1st grade Belgrade	Before physical exercise	28	2	40	29.1	10.8	2.0	-4.29	0.01
	After 45 min physical exercise	28	3	40	33.3	10.1	1.9		
School 2nd grade Belgrade	Before physical exercise	24	6	32	19.4	6.0	1.2	-5.82	0.01
	After 45 min physical exercise	24	14	39	24.8	5.5	1.1		
School 1st -3rd Sombor	Before physical exercise	150	8	40	31.1	8.6	0.7	-10.31	0.01
	After 45 min physical exercise	150	8	40	34.3	7.8	0.6		
Slightly mentaly-retarded children	Before physical exercise	13	6	40	20.6	10.8	2.9	-3.26	0.01
	After 45 min physical exercise	13	8	40	24.8	10.8	2.9		

Basic statistics and the significant differences between the means before and after class without exercise training in individual groups of children are presented in Table 2. It may be noted that although the results have improved, on average, there were no statistically significant increases in mathematics test results. In pre-school in Novi Sad the children even had impaired results. This indicates that the classes where there was no physical exercise did neither produce a significant improvement in mathematics test results, nor in the activation of the children's brain functions.

Table 2: Differences in the successful solving of elementary mathematical problems before and after school hours without physical exercise.

Group	M o d e	N	MIN	MAX	M	SD	SEM	t	p
Preschool Novi Sad	Before drawing class	18	2	18	6.2	4.5	1.0	3.74	0.22
	After 45 min drawing class	18	2	16	4.8	4.2	1.0		
School 1st grade Sombor	Before mathematics class	24	6	40	28.3	9.2	1.8	-1.02	0.32
	After 45 min mathematics class	24	3	40	29.2	10.1	2.0		
School 4th grade Belgrade	Before drawing	18	31	40	37.5	3.3	0.7	-1.36	0.19
	After 45 min drawing	18	31	40	38.5	2.2	0.5		
School 1st grade Belgrade	Before English class	25	13	40	29.3	9.4	1.8	-2.01	0.06
	After 45 min English class	25	9	40	32.9	8.7	1.7		

DISCUSSION

A quick resolution of short and simple mathematical tasks activated a large area of the brain (Kawashima, 2008). It is known that physical exercise with high intensity, even acute (which refers to one or a couple of hours of practice), and in particular chronic (several months and years) can increase brain activity. Thus, increased brain activity in physical training increases the capacity for mathematical function, which affects the integrated activity of the cerebral cortex and, possibly, the entire functioning of the nervous system, the level and quality of concentration, and thus also the cognitive functioning of children.

In this study, we observed a few children with dyspraxia, i.e. who had difficulty in understanding how to plan and organize what their body needs to do or how to sequence and perform movements. Motor planning, also known as praxia, represents the ability of conceiving, planning and execution of an unknown motor activity. Apraxia and dyspraxia are the states of impaired abilities. Quite often, children with difficulties in acquiring school skills also have difficulties in motor processing. For this reason, most children with dyslexia (disorder of acquiring reading skills) and dyscalculia (dis-

order of learning and comprehending mathematical terms and operations) are additionally diagnosed with developmental dyspraxia.

The results of this study confirm the findings of McNaughten and Gabbard (1993) who evaluated the mathematical computation speeds of 120 6th-grade boys and girls and found that performance was signficantly better following paced walks of 30 and 40 min duration than following 20 min of such excercise. There were no differences by gender of subject.

A similar research was conducted by Raviv and Low (1990) who compared children's rapid letter/cancellation performance prior and following physical education classes and science classes. Children's performance improved following both classes, suggesting to the researcher that the physical excitement, associated with traditional physical education classes, does not impair children's academic performance in other classes.

General results obtained in this study are consistent with findings of Tomporowski et al. (2008) who concluded that physical exercise has an effect on specific cognitive functions and the ones most likely to define the role of central executive processor. This processor is a part of the individual self, located in the prefrontal cortex and is responsible for the use of information, engagement, working memory, strategic planning and controlling behavior. Central executive processor governs everyday behavior, i.e., adjusts to the demands of the environment, including its own intellectual abilities.

CONCLUSION

The author believes that even acute intensive physical training can yield positive effects on children's mathematical ability, not only through aerobic exercises, but through a variety of exercises that are common in school gyms. Furthermore, this physical exercises will create better conditions for increasing the quality of neural networks in young children. Generally, regular and well-run physical exercise can positively affect brain health and cognition in children, which could enhance scholastic performance and greater overall cognitive functioning throughout their lives.

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COMPARISON OF SUCCESS OF SLOVENIAN TOP LEVEL ATHLETES AT SENIOR AND JUNIOR COMPETITION LEVEL

Mitija SAMARDŽIJA PAVLETIČ[1], Iztok RETAR[2], Poljanka PAVLETIČ SAMARDŽIJA, Edvard KOLAR[1]

[1]University of Primorska, Faculty of Mathematics, Natural Sciences and Information Technology, Koper, Slovenia
[2]University of Primorska, Science and Research Centre, Institute for Kinesiology Research, Koper, Slovenia

Corresponding author:
Iztok RETAR
University of Primorska, Science and Research Centre, Institute for Kinesilogy Research, Koper, Slovenia
e-mail: Iztok.Retar@zrs.upr.si

ABSTRACT

In this study, we examined whether the Slovenian athletes who are the holders of medals in major competitions in junior categories are among the winners of the most prestigious awards also in senior categories. On a sample of 192 elite sportsmen and sportswomen 98, who during the period from 1 January 2008 to 31 December 2013 achieved the positions from the first to the third place in selected Olympic disciplines in the biggest competitions at junior level competitions and at senior level competitions, we found a result dropout rate of athletes who achieved top results in junior categories after their transition to the senior category.

We found that the Slovenian athletes in senior competition level on average achieve top level results at the age of 27. Furthermore, we found out that a half (49 %) of the athletes who achieved excellent results in senior category had not achieved superb results earlier in junior category, and that almost 30 % of athletes who achieved their best results at major competitions on senior levels failed to obtain the status of an athlete of perspective class at the time when they competed in junior category. We have come to the conclusion that unlike the sportsmen achieving top results only a small group of sportswomen achieve top level results. We recommend a systemic analysis of expert professional work in individual sports, adoption of certain measures to improve the competencies of sports managers who coordinate the work of expert teams and the contribution of many other stakeholders who are co-creators of top sports achievements. In addition, we would further suggest the analysis of the categorisation system,

particularly in the area of determining the status of perspective athlete. We believe it would be wise to carry out a further in-depth research that would respond to the question who are the key stakeholders and how to influence them in order to reduce the result dropout rate of top young athletes in the transition period to senior categories and to increase the total number of top athletes.

Keywords: *sports management perspective/athletes, top level sport result, major competitions*

PRIMERJAVA USPEHOV SLOVENSKIH VRHUNSKIH ŠPORTNIKOV NA RAVNI ČLANSKE IN MLADINSKE REPREZENTANCE

POVZETEK

V raziskavi proučujemo, ali se slovenski športniki, ki so nosilci odličij na največjih tekmovanjih v mladinski kategoriji, uvrščajo tudi v članski kategoriji med dobitnike prestižnih odličij. Analizirali smo vzorec 192 vrhunskih športnikov in 98 športnic, ki so v obdobju od 1. 1. 2008 do 31. 12. 2013 dosegli uvrstitev v izbranih olimpijskih panogah od prvega do tretjega mesta na največjih tekmovanjih v mladinski in v članski konkurenci. Ugotovili smo rezultatski osip pri športnikih, ki so v mladinskih kategorijah dosegali vrhunske rezultate po prehodu v člansko kategorijo. Ugotovili smo tudi, da slovenski športniki v članski konkurenci v povprečju dosegajo vrhunske rezultate razmeroma pozno(pri sedemindvajsetih letih). Ugotavljamo še, da polovica (49 %) športnikov, ki so dosegli vrhunski rezultat v članski kategoriji, le-tega niso dosegli v mladinski kategoriji, skoraj 30 % športnikom, ki so dosegli vrhunski rezultat na največjih tekmovanjih v članski konkurenci, pa ni uspelo pridobiti statusa športnika perspektivnega razreda v času, ko so tekmovali v mladinski kategoriji. Ugotavljamo tudi, da za razliko od športnikov dosega vrhunske rezultate le majhna skupina športnic. Na podlagi ugotovitev predlagamo izvedbo sistemske analize strokovnega dela po posameznih športnih panogah. Priporočamo tudi uvajanje ukrepov izboljšanja kompetentnosti športnih menedžerjev, ki koordinirajo delo strokovnega tima in drugih številnih deležnikov, ki so soustvarjalci vrhunskih športnih dosežkov. Prav tako še priporočamo analizo modela kategorizacije, zlasti na področju določanja statusa perspektivnega športnika. Predlagamo tudi nadaljnje poglobljene raziskave, ki bodo lahko odgovorile, kateri so ključni deležniki in kako vplivati nanje, da bomo zmanjšali

osip vrhunskih mladih športnikov pri prehodu v članske kategorije in povečali število vrhunskih športnic.

Ključne besede: *športni menedžment, perspektivni športniki, vrhunski športnik, vrhunski rezultat, velika tekmovanja*

INTRODUCTION

Slovenia is a sports prosperous country. It is true that it cannot compete in the absolute number of medals at major competitions with larger countries, but in relative numbers (number of medals per capita or in relation to GDP) Slovenia is among the best in the world. Even at the Winter Olympic Games Sochi 2014, Slovenia was placed, relatively speaking, according to the Bloomberg portal to the second place, just after Norway (Bloomberg, 2014). Other studies also estimate Slovenian sport as successful at the international level. Number of medals won at the biggest competitions, i.e., summer and winter Olympic Games and World and European Championships, shows a positive trend since Slovenia's independence (Grujič, 2013; Kolar, Bednarik, Kovač, & Jurak, 2007), which automatically increases the number of categorised athletes in both world and international class (Kolar & Rajšter, 2010). The document titled "Conditions, rules and criteria for the registration and categorization of athletes in the Republic of Slovenia" stipulates that each registered athlete who acquired the title of junior, national, prospective, international or world class is a categorised athlete. The same document also provides the status of categorized athlete, and in addition to the registration, among other conditions, it also defines the condition that athletes have to, in order to obtain categorisation with their sports achievements, meet at least one of the criteria for categorization of individual sports (in our case, the criteria for international and global class) ("Pogoji, pravila in kriteriji za registriranje in kategoriziranje športnikov v Republiki Sloveniji ", 2013).

Analysis of the top results in junior category shows even a better situation because Slovenian young athletes reach a greater number of rankings among the winners of medals at the biggest junior category tournaments, compared to athletes in senior categories at the competitions of the same level. At the Youth Olympic Games (period 1993–2014) Slovenia was with its 17 medals (5 gold, 6 silver and 6 bronze) ranked to the 22nd place (absolute result) of a total of 114 countries ranked winning medals ("All-Time Youth Olympic Games medal table", 2014). High rankings of young athletes were also reflected in the increase of the number of athletes categorized "prospective class", which in the period from 2001 (179 prospective athletes) to 2009 (259 prospective athletes) grew on average by 5.5 % per year, or by 8.9 of athletes per year (Kolar & Kovac, 2010). A similar positive trend continued during the period 2010-2013. In his analysis, Grujic (2013) notes that comparatively between 2009 and 2010, there was an increase in the number of prospective athletes by 66 %. Such a leap was caused by the change of the categorization rules, which have been valid since 2009. In 2011 and 2012,

the increase was stable at an average of 9 %. In 2013 there was a decline in the number of prospective athletes by 1.5 %. Despite the negative trend in 2013, we found that the Slovenian young athletes are successful because in 2013 up to 510 athletes were recorded in the prospective class (Grujic, 2013). Individual analysis of existing sources indicates that the Slovenian athletes are successful in individual categories. We could not find comparable studies in the domestic and foreign literature. We assume that the reason for this lies in different systems of status rights enforcement and, thus, also in categorizing athletes; from that reason our research is specific.

The aim of the survey was to determine whether the Slovenian athletes, medal holders from the biggest competitions in senior category, also rank among the winners of medals at major competitions in junior category. We assumed, indeed, that the result dropout of athletes who in the junior category achieved top results is present in their transition to the senior category.

Therefore, we posed the following research questions:

– Are Slovenian athletes of junior or senior categories more successful at the biggest competitions?
– Did Slovenian athletes who in senior category achieved rankings among the top three in the biggest competitions achieve the same comparable rank in the junior category?
– Are the medal holders at the biggest competitions in the senior category the athletes who in the junior categories achieved mediocre results?

RESEARCH METHODS

The sample in the study is represented by the top Slovenian athletes (Table 1) who during the period from 1. 1. 2008 to 31. 12. 2013 achieved a ranking from the first to the third place in the biggest competitions at the junior competition level (World and European Youth Olympic Games, World and European Championships, Grand Slam in tennis) and in the senior competition level (Olympic Games, World and European Championships, Grand Slam in tennis), all in the Olympic sports.

Table 1: Basic characteristics of the sample

	Number of events	Number of athletes	Number of athletes JR*	Number of athletes SR**	Average age of athletes SR**
Men	246	192	148	44	27.75 (SD 6.59) years
Women	137	98	68	30	25.23 (SD 5.21) years
Total	383	290	216	74	

**JR – junior category; **SR - senior category*

The study covered the athletes from the following sports:

- junior category: the stadium athletics, sailing, judo, kayaking and canoeing flatwater and slalom, road and mountain cycling, target archery, table tennis, volleyball, swimming, handball, skiing (alpine, snowboard, Nordic combined, ski jumping, cross-country skiing), taekwondo wtf, tennis, rowing.
- senior category: the stadium athletics, gymnastics, sailing, judo, kayaking and canoeing flatwater and slalom, mountain biking, target archery, table tennis, swimming, skiing (alpine, biathlon, snowboarding, ski jumping, cross-country skiing), shooting , taekwondo wtf, rowing.

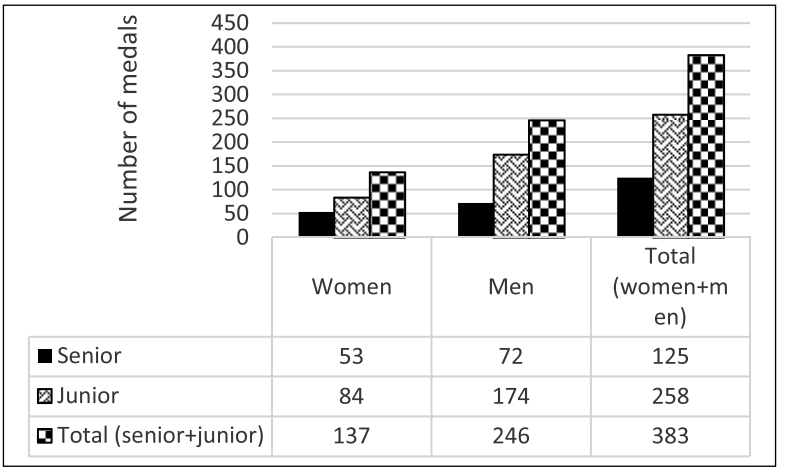
Data sources were as follows:

- Web application "Athletes" - collection of information on the categorisation and the achievements of athletes ("Seznam kategoriziranih športnikov", 2014)
- Olympic Committee of Slovenia ─ Association of Sports Federations (the OCS) ─ Sports Results ("Športne igre", 2014)

Data obtained to look for answers have been elaborated by descriptive statistical parameters (frequency, average value, contingency table). Data processing was carried out with the software package SPSS and Microsoft Excel.

RESULTS

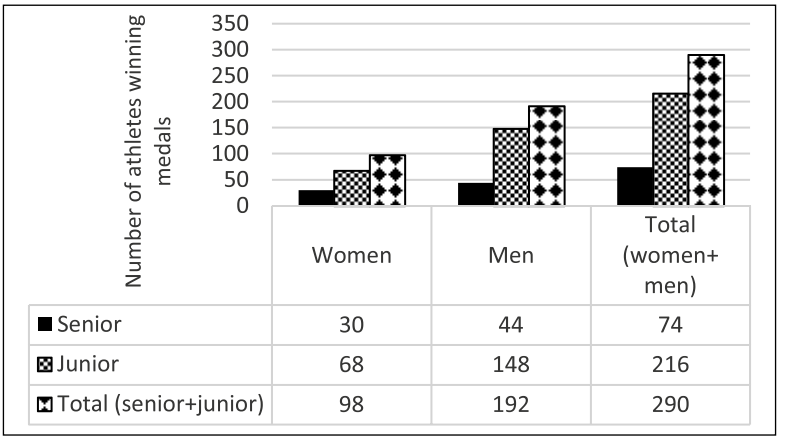
In the period 2008–2013, Slovenian athletes achieved in extremely numerous high-profile results in Olympic sports in all major competitions, and were ranked among the top three even up to 383 times (Figure 1). From these data it is evident that the junior category in the same period reached by 106 % more rankings among the top three in total in the selected competitions than athletes of senior category. At the same time, we have found out that given the total incidence of Slovenian athletes ranking among the top three in the selected competitions for women is up to 37 % and for men over 150 % more such achievements in junior category than in senior category (Figure 1).



	Women	Men	Total (women+men)
Senior	53	72	125
Junior	84	174	258
Total (senior+junior)	137	246	383

Figure 1: Number of Slovenian athletes' rankings from 1st to 3rd place in selected competitions given the category and gender in the period 2008–2013.

With reference to the overall incidence of 383 rankings among the top three in the selected competitions, we have found out that that men are more successful, reaching 80 % more rankings among the top three in the selected competitions compared to women (Figure 1). Number of rankings may be different from the number of athletes who have achieved such results, as one athlete in the monitored six-year period may have achieved that rank for several times. The data shown in Figure 2 determine the number of athletes who achieved ranking among the top three in the selected competitions in the period 2008–2013 at least once. The difference in the overall incidence of rankings (Figure 1) and the total incidence of athletes who have achieved at least one criteria classification (Figure 2), reaches up to more than 30 % in favour of the rankings.

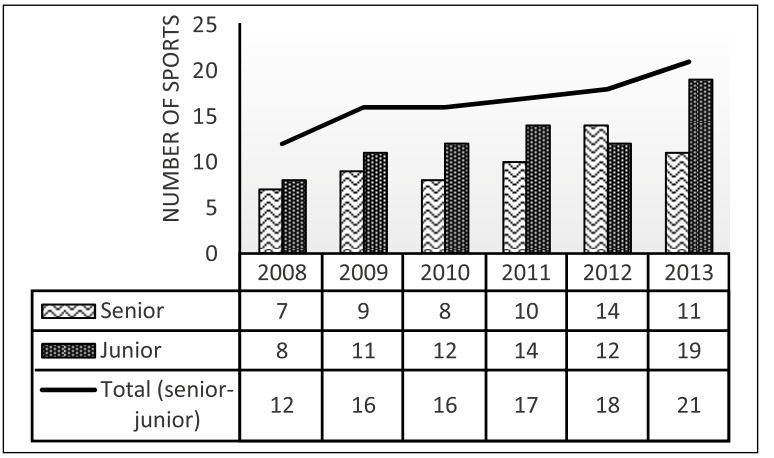


	Women	Men	Total (women+ men)
Senior	30	44	74
Junior	68	148	216
Total (senior+junior)	98	192	290

Figure 2: Number of athletes who reached rankings form the 1st to 3rd place at selected competitions in relation to the category and gender in the period 2008–2013.

We have learned that athletes of senior category ranked at selected competitions among the top for 125 times (Figure 1). The total number of athletes who achieved this rank is 74, which means that most athletes achieved top result several times (Figure 2). The figure is actually encouraging, because it tells us that Slovenian coaches know how to keep a top level professional athlete at the top level for a long period of time. From the data it is also evident that junior category achieved 191 % more rankings among the top three in the selected competitions than in the senior category. At the same time, we see that parallel to the total appearance of Slovenian athletes who were ranked among the top three in the selected competitions for women 127 % and for men 236 % there are more such events in junior rather than in senior category (Figure 2).

For easier understanding and identifying the level of sport development at the national level, it makes sense to analyse the sports in which the criteria results have been achieved. At the Summer Olympics, for example, 38 sports are included, and in Winter Olympic Games 15 sports ("Olimpijske športne panoge" 2014) which in total comes to 53 sports. Slovenian athletes have ranked among the top three in 23 Olympic sports at the biggest competitions in 2008–2013, which represents 43 % of the total number of Olympic sports.



	2008	2009	2010	2011	2012	2013
Senior	7	9	8	10	14	11
Junior	8	11	12	14	12	19
Total (senior-junior)	12	16	16	17	18	21

Figure 3: Number of sports in which athletes achieved ranking from 1st to 3rd place in selected competitions regarding the category, in the period 2008–2013.

The trend of increase in the number of sports in which Slovenian athletes achieve rankings from 1st to 3rd place in the selected competitions is positive (Figure 3). It is strongly positive in the junior competitions, which suggests that lower result performance in the senior category is not a reflection of the shortcomings of the expertise, but the restrictions may be found, according to our assumptions, elsewhere.

Table 2: Number of rankings from 1st to 3rd place in selected competitions of athletes in junior category by sports in the period 2008–2013.

Count – JUNIOR CATEGORY								
		Year of the achieved result						Total
		2008	2009	2010	2011	2012	2013	
NSF	ATHLETICS – STADIUM/TRACK AND FIELD	0	1	1	3	0	6	11
	SAILING	3	2	1	1	1	4	12
	JUDO	1	3	4	5	4	6	23
	KAYAK CANOE ─ FLATWATER	0	0	0	0	2	2	4
	KAYAK CANOE ─ SLALOM	5	7	4	2	7	9	34
	CYCLING ─ ROAD	0	0	1	1	2	1	5
	CYCLING ─ MOINTAIN	1	0	1	0	0	1	3
	ARCHERY ─ TARGET	0	0	0	0	5	2	7
	TABLE TENNIS	0	0	1	0	0	4	5
	VOLLEYBALL	0	0	0	0	0	12	12
	SWIMMING	2	1	0	4	0	2	9
	HANDBALL	0	15	15	0	13	12	55
	SKIING ─ ALPINE	0	1	1	2	1	4	9
	SKINING ─ SNOWBOARD	1	1	0	3	0	1	6
	SKIING ─ NORDIC COMBINED	0	3	4	1	0	0	8
	SKIING – SKI JUMPING	1	4	3	1	7	10	26
	SKIING – CROSS COUNTRY	0	0	0	1	3	1	5
	TAEKWONDO ─ WTF	0	1	1	2	1	1	6
	TENNIS	4	0	0	6	0	1	11
	ROWING	0	0	0	4	1	2	7
Total		18	39	37	36	47	81	258

Table 3: Number of rankings from 1st to 3rd place in the selected competitions of athletes in senior category by sport in the period 2008–2013.

Count – SENIOR CATEGOTRY								
		Year of the achieved result						Total
		2008	2009	2010	2011	2012	2013	
NSF	ATHLETICS – STADIUM/TRACK AND FIELD	1	2	0	1	1	0	5
	SAILING	2	1	1	0	1	0	5
	JUDO	3	0	0	0	3	1	7
	KAYAK CANOE ─ FLATWATER	3	2	4	4	5	5	23
	KAYAK CANOE ─ SLALOM	0	0	0	0	1	1	2
	CYCLING ─ ROAD	0	3	8	4	1	4	20
	CYCLING ─ MOINTAIN	0	0	0	1	1	2	4
	ARCHERY ─ TARGET	1	0	2	0	1	0	4
	TABLE TENNIS	0	1	0	1	0	0	2
	VOLLEYBALL	1	0	0	0	5	0	6
	SWIMMING	0	1	1	1	0	1	4
	HANDBALL	0	1	0	0	4	1	6
	SKIING ─ ALPINE	0	0	0	1	0	1	2
	SKINING ─ SNOWBOARD	0	0	0	4	1	1	6
	SKIING ─ NORDIC COMBINED	0	0	1	1	0	0	2
	SKIING – SKI JUMPING	1	6	2	2	1	1	13
	SKIING – CROSS COUNTRY	0	0	1	0	1	2	4
	TAEKWONDO ─ WTF	0	4	0	0	6	0	10
Total		12	21	20	20	32	20	125

The results emphasise the positive trend and growth in the number of sports, however, they also highlight deficiencies and poor participation in women's sports. One of the specific findings is the athlete's age in the senior category, who achieved ranking from 1st to 3rd place in the selected competitions. We have found out that Slovenian athletes in the senior competition level on average achieve top results at the age of 27.75 years (men) and 25.23 years (women), i.e., at the age of sports maturity. Along individual sports we noticed an unsystematic situation in achieving top results in the observed period (Table 2 and Table 3). The exception is judo (Figure 4).

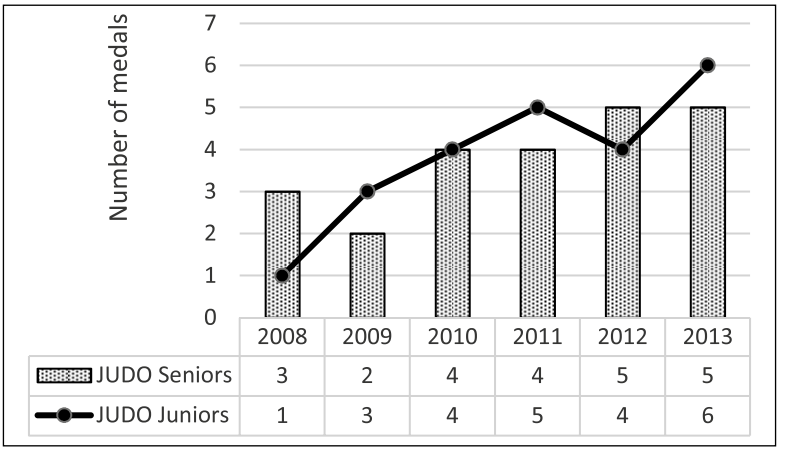


Figure 4: Example of good practice in judo.

A specific finding was the athlete's age in senior category achieving the rank of 1st to 3rd place in selected competitions. We concluded that in senior category Slovenian athletes on average achieve top level results at the age of 27, i.e., in the period of sports maturity.

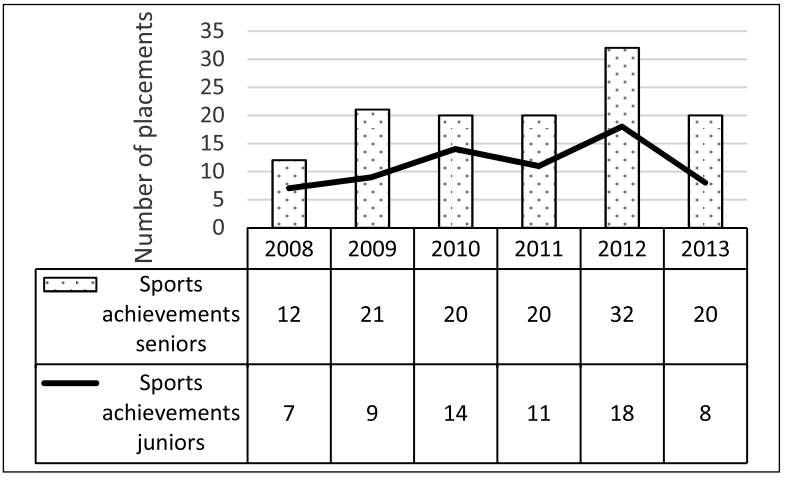


Figure 5: Comparison of rankings from 1st to 3rd place in the senior category with the junior category.

Below, we examine the relationship between the athletes who achieved top result in the senior category and their results success in the junior category. Figure 5 shows the number of rankings from 1st to 3rd place in the biggest competitions in the senior category for the period 2008–2013 and the number of athletes from the already mentioned who achieved comparable rank in junior category. For example, 12 athletes from senior category achieved top result in 2008, seven of which achieved a comparable result in the junior competition level. We have found out that a large number of athletes achieved their best results only in the senior competition level. After calculating separate proportions, we have found out that, on average, 47 % of top athletes who were in the senior category in the period 2008–2013 achieved the first three places. They did not achieve them at junior competition level (Figure 5). Why this phenomenon occurs, needs to be further investigated.

The data indicate that many young athletes get lost on their way to a top result at the senior competition level. Up to 49 % of athletes who achieved excellent results in senior category but were not superb in junior category; almost 30 % of the athletes who achieved top result in the biggest competitions at senior competition level, failed to obtain the status of a prospective athlete at the time when they were competing in junior category.

Table 4: Comparison of athletes' rankings by sports from 1st to 3rd place in senior category with junior category ─ the prospective class.

NSF ─ SPORT		Number of athletes NOT ACHIEVING prospective class	Number of athletes ACHIEVING prospective class
ATHLETICS ─ STADIUM/TRACK AND FIELD	f	1	1
	f %	50.0 %	50.0 %
GYMNASTICS ─ ARTISTIC	f	1	2
	f %	33.3%	66.7%
SAILING	f	3	2
	f %	60.0 %	40.0 %
JUDO	f	3	6
	f %	33.3 %	66.7 %
KAYAK CANOE ─ FLAT WATERS	f	0	1
	f %	0.0 %	100.0 %
KAYAK CANOE ─ SLALOM	f	1	10
	f %	9.1 %	90.9 %
CYCLING ─ MOUNTAIN	f	2	1
	f %	66.7 %	33.3 %
ARCHERY ─ TARGET	f	0	3
	f %	0.0 %	100.0 %
TABLE TENNIS	f	1	0
	f %	100.0 %	0.0 %
SWIMMING	f	0	5
	f %	0.0 %	100.0 %

SKIING – ALPINE	f	0	1
	f %	0.0 %	100.0 %
SKIING – BIATLON	f	1	3
	f %	25.0 %	75.0 %
SKIING – SNOWBOARDING	f	0	1
	f %	0.0 %	100.0 %
SKIING – SKI JUMPING	f	1	3
	f %	25.0 %	75.0 %
SKIING – SKI JUMPING	f	0	1
	f %	0.0 %	100.0 %
SHOOTING	f	4	4
	f %	50.0 %	50.0 %
TAEKWONDO – WTF	f	2	1
	f %	66.7 %	33.3 %
ROWING	f	0	9
	f %	0.0 %	100.0 %
Total	f	20	54
	f %	27.0 %	73.0 %

Table 4 shows the athletes in different sports, who did or. Respectively. did not achieve the status of a prospective athlete in junior category, and achieved rankings from 1st to 3rd place in the biggest competitions in senior category. Since the dispersion of the results was large and the number of classifications by individual sports relatively low, the interpretation is limited. In the monitored period 2008–2013 women reached by 32 % less top results than men in senior competition level. Given the total number of athletes in senior category, there were 50 % fewer athletes who did not achieve top results in the junior category among men and 48 % fewer among women. The proportion between athletes in senior category who achieved top results at the biggest competitions and the athletes who failed to gain a perspective class in the junior category between men and women is equal, which is 27 % less.

DISCUSSION

We have noted that the Slovenian athletes are, seen through the years and in their absolute achievements, very successful in both of the monitored categories, junior and senior. Depending on the number of inhabitants the result performance of Slovenian athletes at the biggest competitions is above average, when compared to other countries (Bloomberg, 2014; Grujič, 2013; Kolar et al., 2007). Slovenian athletes achieved top

level results in the period 2008–2013 in 23 Olympic Sports, representing 43 % of the total number of Olympic sports.

For better understanding, we would like to highlight the limitations resulting from the research sample and instruments. We opted for athletes who had achieved one of the first three positions in major competitions. Because of this, some top athletes were dropped out. Another limitation is that we followed the results retrospectively rather than longitudinally. The next restriction is related to the follow-up period of the result success (six years). Another limitation is also that we followed up only the Olympic sports.

Despite the limitations, the results and analysis of the results highlight the success of Slovenian athletes in the biggest competitions, while the in-depth analysis unveils the deficiencies of Slovenian professional sport. The data clearly show that the balance in achieving top results for the period 2008–2013 has been disturbed, and between junior and senior category, since there are by 106 % more top level results achieved in junior categories at the biggest competitions than in senior categories. At the same time, the result success identified at the state level appears within the national sports federations as unsystematic, almost at random in junior and senior competition levels. The exception is the Judo Federation of Slovenia, which has a positive trend and systematically achieved superior results over the period 2008–2013, both in junior and in the senior competition level.

Comparison in success performance by gender has shown that Slovenian female athletes have lower dispersion of top results, smaller number of rankings among the top three places at the biggest competitions and a smaller number of individuals that achieve top results in comparison with the Slovenian male athletes.

Good performance in the junior and senior categories is above average, as we have already stated above. By comparing the individual success of each athlete in junior and senior competitions we can ascertain that during the transition from junior to senior competition level many successful athletes slip into average. This phenomenon is negative for the athlete, for his basic organization, i.e., his sports federation, and this fact also reduces the success at the state level.

It is interesting to find out that in the senior competition level the average age of the male athletes is 27 years and the average age of female athletes is 25 years when they achieve excellent results. For this reason, we could not conduct a longitudinal study and monitor the development of the outcome of each junior athlete to senior competition level, as we would have to obtain the results of all juniors for selected matches for a much longer period. This is also one of the weaknesses of this research. For this reason, we monitored the athletes who in the senior competition level achieved a criterion result and retroactively identified their best rankings in the junior category and then compared them with benchmark result (ranking in selected competitions and categorization).

Based on retrospective analysis of data (from senior to junior category), we found out that 49 % of athletes who achieved a ranking from 1st to 3rd place in selected competitions, did not achieve such an outcome in selected competitions in the junior competi-

tion. The same analysis found that 27 % of all those who have reached the rank of 1st to 3rd place in selected competitions, failed to obtain the status of an athlete of prospective class. ⁻In any case, there is an extremely large gap in the athlete's performance in the junior and in the senior competition level, which reveals that it is not necessary that the same athlete is successful in results in the junior competition in order to make a successful appearance in the senior competition.

In addition, junior competition criterion results for the period 2008–2013 were reached by 191 % more athletes than in the senior competition. Based on these data, we estimate that there is a risk that the vast majority of junior athletes (more than 70 %) who achieved a criterion result in the junior category will not be able to repeat it in the senior category.

Comparative analysis among sports regarding the number of holders of the status of prospective class in the junior category for athletes who achieved the rank from 1st to 3rd place in senior category in the biggest competitions, offers interesting findings and highlights the potential shortcomings of categorisation system for certain sports. Due to the limitation of research, which is mainly subject to the lack of longitudinal monitoring of the transition from junior to senior category, we can claim and point out that it would seem necessary to examine the categorization system. In particular, it would be necessary to pay attention to the determination of the status of prospective athlete in view of the facts found in the study.

The Slovenian elite sport has many successful junior athletes and also dropout rate in respect of the performance of the same athletes in the senior competition level. It would be advisable and helpful to explore, in cooperation with national sport federation's experts, the content characteristics of the system that makes this possible, and to contribute in this way to the reduction of the result dropout rates of successful junior athletes later in senior competitions.

Quite a few studies (Arampatzis, Stafilidis, Morey-Klapsing, & Bruggemann, 2004; Bompa, 2001; Bon, 2001; DiFiori, Puffer, Aish, & Dorey, 2002; Frish et al., 2008; Kandare & Tušak, 2010; Kujala et al., 1995; Markolf, Shapiro, Mandelbaum, & Teurlings, 1990; Mlinarec, 2010; Montgomery, 1998; Pettersson & Lorentzon, 1993; Pocecco et al., 2013; Pori, 2003; Reilly, 1990; Sattler, 2010; Ušaj, 2003; Wanivenhaus, Fox, Chaudhury, & Rodeo, 2012) have already pointed out the problems in training young athletes (health care, psychological preparation, management of the athlete's career, etc.), which can be applied also to the findings of our research.

Most of the researchers suggest that coaches do not take into consideration enough the developmental characteristics of young athletes which lead to a saturation and fatigue, and to an increased number of sports injuries due to overloading. The above mentioned authors attributed saturation and fatigue mainly to high intensity and early specialization of athletes. Overload syndromes are also inseparably linked to these factors, resulting in an increased number of chronic and recurrent sports injuries. From this reason, an athlete is not able to train for longer periods and consequently his/her progress slows down or is even limited.

Competent managers are equally important. The study titled "Key competences Slovenian sports managers" (Retar, Plevnik, & Kolar, 2013) emphasises particularly the importance and the role of a competent sports manager whose key objective is to develop a positive working environment, to function as a professional and moral authority and to properly organise and delegate the tasks. Other, also very important skills are the ability to work with people and apply the acquired knowledge in practice and to possess the ability to generate new ideas.

By all means, the findings may provide support in the implementation of strategic objectives that are set out in the National Programme of Sport (the top sports programme), in particular in the maintenance of the number of world-class athletes, and in maintaining the number of medals won at the Olympics, World Championships, European Championships and the final rankings in the World Cups as well as in comprehensive development of top athletes during their sporting career and after it (*Nacionalni program športa v Republiki Sloveniji 2014–2023,* 2014).

Since the addressed problem has not been studied yet, we cannot compare our data to determine whether the observed difference is a deviation or is it a natural phenomenon. We suggest that further in-depth researches follow the trend of transfer from junior to senior category and the trend of achieving the expected top results. The findings given through the analysis of the results and the discussion are not a criticism of Slovenian sport or expert staff. The aim of the research was to identify shortcomings as objectively as possible, in order to initiate relevant measures towards raising the level of sporting success of Slovenian athletes.

CONCLUSIONS

The purpose of this study is to contribute to the development of Slovenian sport with a critical analysis of individual segments. In this paper we define guidelines for managers in Slovenian sport in order to preserve the achieved level and possibly to raise it to a higher level despite the period of global economic, financial and moral ─ ethical crisis. The study "Social competencies of Slovenian sport managers" (Retar, Pišot, & Kolar, 2014) showed that very important social competences of managers are as follows: "developing a positive working environment", "presentation of professional and moral authority" and "proper organising and delegating tasks", which may explain both sports and business performance of sports organizations. Our findings and guidelines for the preservation of result performance in the senior category, for the increase in the number of top athletes, for the systematisation of professional work in individual sports are based also on the improvement of sports managers' key competencies. Managers do the planning, organising, implementing, providing the funds and supervising of the work of professional team members and a number of other stakeholders without whom there would be no top sports achievements. Therefore, we suggest further in-depth research that will respond to the question who are the key stakeholders and how

to influence them in order to improve the areas of weakness, defined in our study, to a higher level.

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THERMOREGULATION IN CHILDREN: EXERCISE, HEAT STRESS & FLUID BALANCE

Shawnda A. MORRISON[1,2], Stacy T. SIMS[3,4]

[1]University of Primorska, Faculty of Mathematics, Natural Sciences and Information Technology, Koper, Slovenia
[2]University Medical Centre, Institute of Clinical Neurophysiology, Division of Neurology Ljubljana, Slovenia
[3]Stanford University School of Medicine, Stanford Prevention Research Centre Stanford, CA, USA
[4]OSMO Nutrition, Inc. 725 Center Blvd, Fairfax, CA, USA

Corresponding author:
Shawnda A. MORRISON
University of Primorska, Titov trg 4, 6000 Koper, Slovenia
Tel: +386 5 6117500, Fax: +386 5 6227530
e-mail: shawndamorrison@hotmail.com

Co-author contact information:
Stacy T. SIMS
OSMO Nutrition, Inc. 725 Center Blvd, Fairfax, CA, USA, 94930
Tel: 415-258-1613,
e-mail: stsims@stanford.edu

ABSTRACT

This review focuses on the specific physiological strategies of thermoregulation in children, a brief literary update relating exercise to heat stress in girls and boys as well as a discussion on fluid balance strategies for children who are performing exercise in the heat. Both sport performance and thermoregulation can be affected by the body's water and electrolyte content. The recommendations for pre-pubertal fluid intake have been generalized from adult literature, including a limited concession for the physiological differences between adults and children. Considering these body fluid shifts, carbohydrate-electrolyte drinks are thought to be an essential tool in combating dehydration as a result of active hyperthermia (i.e. exercise), thus we examine current

hydration practices in exercising children. Finally, this review summarizes research which examines the relationship between cognition and hypohydration on young athletes' performance.

Keywords: *childhood, cognition, fluid replacement, heat stress, hyponatremia, sweat rate, work*

URAVNAVANJE TEMPERATURE PRI OTROCIH: VADBA, VROČINSKI STRES IN URAVNOVEŠANJE TEKOČIN

POVZETEK

Članek se osredotoča na specifične fiziološke strategije termoregulacije pri otrocih, obsega pa tudi kratek povzetek iz novejše literature, ki se nanaša na vadbo in vročinski stres pri dekletih in fantih, ter razpravo o strategijah uravnovešanja tekočin pri otrocih, ki telovadijo v vročini. Na športne dosežke in termoregulacijo lahko vplivata voda v telesu in vsebnost elektrolitov. Priporočila glede vnosa tekočine v obdobju pred puberteto so posplošena in izhajajo iz literature, ki proučuje odrasle, omejenost se pa kaže pri upoštevanju fizioloških razlik med odraslimi in otroki. Glede na spremembe v količini telesnih tekočin so ogljikohidratne-elektrolitske pijače ključno orodje v boju proti dehidraciji, ki nastopi kot posledica aktivne hipertermije (tj. vadbe), s čimer preučujemo sedanje prakse hidracije pri otrocih, ki telovadijo. V zaključku tega članka pa povzemamo rezultate raziskave, ki proučuje odnos med kognicijo in hipohidracijo ter vplive na dosežke mladih športnikov.

Ključne besede: *otroštvo, kognicija, nadomeščanje tekočin, vročinski stres, hiponatriemija, delež znojenja*

INTRODUCTION AND REVIEW METHODOLOGY

To assist in the compilation of up-to-date, relevant information, we utilised a semi-structured review of the literature beginning with the free-form question "what is the state of knowledge regarding child hydration needs in the case of exercise induced heat strain?" To this end, the population in question focused on children, generally defined as having a pre-pubertal chronological age range between 4 and 12 years old. The study interventions needed to include some form of exercise, or target a particular athletic training cohort, whilst outcomes could be defined in terms of performance, physiological or psychophysical outcome variables (Table 1). Capturing as many relevant sources

as possible required using the common Medical Subject Headings (MeSH) from the PubMed database, accessed on Oct. 12th, 2014 (Figure 1). Review articles or non-novel methodology studies were excluded from the review criteria. With this literature as a background, the following information has been gleaned regarding exercise, heat stress and fluid balance in children.

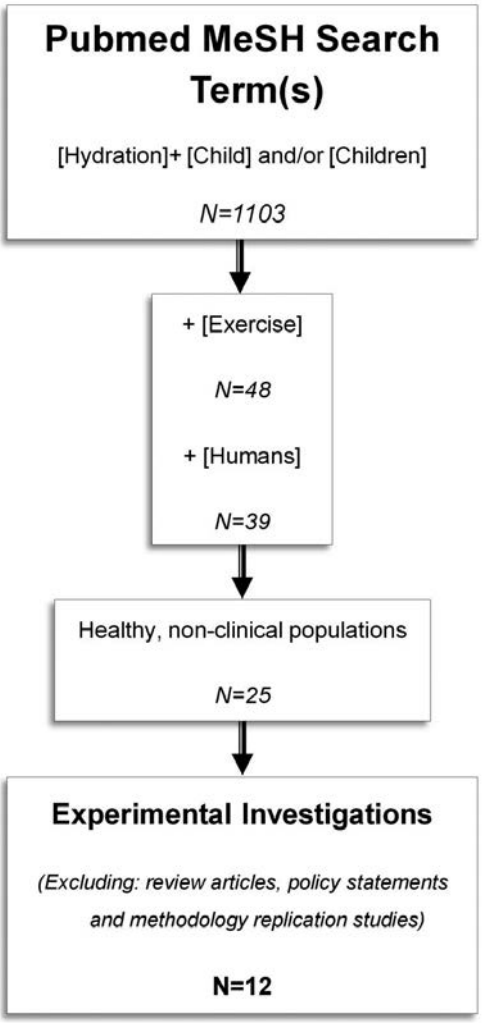

Figure 1: Literature search algorithm for identifying appropriate research articles to include in the present review.

THERMOREGULATION IN CHILDREN

Elevations in core temperature provide the principal stimulus for initiating and controlling heat loss mechanisms (Gisolfi, 1989), thus avoiding premature fatigue and thermal injury. These mechanisms are both autonomic and behavioural in nature. Autonomic responses include the release of vasoconstriction of cutaneous blood vessels, active vasodilation of shunt vessels, and activation of eccrine sweat glands (Gagge & Gonzalez, 1996). Heat is then dissipated primarily via dry (radiation, convection) and wet (evaporation) mechanisms. When exercising in a natural environment, the radiant energy from the sun can contribute a significant heat load to the exercising individual (Nielsen et al., 1988), whilst the increased production of heat from the working muscles further accentuates a rise in core temperature (Asmussen & Boje, 1945). Airflow can impact both dry and evaporative heat transfer, the coefficients of which have been previously established for various airflow velocities using naphthalene sublimation (Nishi & Gagge, 1970). Thus, the ability to maintain heat balance in a given environment is reliant on an individual's metabolic rate, their external work rate, convective, radiative, evaporative and conductive heat exchange, which can also depend on one's cardiovascular and sweating response capabilities.

The ability of pre-pubertal children to regulate their body temperature under thermoneutral conditions remains similar to adults, albeit via different cooling strategies. In a hot environment however, heat-related illnesses can vary from mild (heat rashes, cramps) to severe (heat exhaustion, heat stroke) for any age group. During exercise, core temperature increases relative to work output, and these increases are exacerbated by hot, humid environmental conditions (Reviewed in: Rowland, 2008). Thermoregulation is significantly altered in the paediatric population compared to adults (Bar-Or, 1989) in terms of both morphological and physiological differences between groups when exercising in the heat. Specifically, children rely more heavily on dry mechanisms of heat exchange (conduction, convection), since their sweat output is approximately half that of adults (Meyer et al., 1992), and even individual sweat drop size is smaller, with a gradual increase in drop area as the maturation process continues (Falk et al., 1992). Historically, children were thought to be at a thermoregulatory disadvantage when under environmental heat stress compared to their adult counterparts (Bytomski & Squire, 2003). This may be owing to a greater reliance on increased cutaneous blood flow, which may ultimately reduce cardiac output, especially in the heat. Evidence suggests that incidence rates of heat illness in children may be higher than in adult populations (Adcock et al., 2000; Nakai et al., 1999); however comparative-based research studies are often conducted in laboratory-based environments without the benefit of realistic airflow, or relative work rates, making generalizability to field-based activities difficult.

Exercise as external stressor

Prolonged exercise itself has a marked effect on the cardiovascular system, to such extent that increases in heart rate, decreases in stroke volume, and changes in the distribution of blood flow and volume are significant, ultimately lowering cardiac output and mean arterial blood pressure. An upward drift in the heart rate, known as cardiovascular drift, can occur after only ~10 min of exercise (Pitts et al., 1944). Traditionally, this drift has been attributed to a progressive increase in cutaneous blood flow, by up to eight $L \bullet min^{-1}$, in attempt to attenuate the rise in core temperature (Rowell, 1993). An increase in the heart rate may be the underlying factor responsible for decreased stroke volumes during prolonged exercise (Fritzsche et al., 1999), although neither theory is mutually exclusive from the other. Indeed, decreases in cardiac filling time due to higher heart rates causing lower stroke volume with hyperthermia can theoretically reduce central blood volume, and central venous pressure, impairing cardiovascular function, especially in conditions where dehydration occurs (González-Alonso et al., 1999).

Dehydration and high core temperature can not only worsen each other, but can independently and additively raise heart rate and decrease stroke volume and cardiac output during upright exercise (González-Alonso et al., 1997). Although sweating is a powerful mechanism of dissipating heat, accounting for up to 600 $kcal \bullet hr^{-1}$ in warm, dry conditions, losses of water can be in excess of two $L \bullet hr^{-1}$ (Rowell, 1983), or more, depending on the training status and the age of the individual. Additional cardiovascular responses include marked changes in regional blood flow, triggering significant volume changes in the central blood reservoir and splanchnic bed due to a reduction in central blood volume, while total blood volume slowly decreases due to sweat and respiratory losses. To exacerbate matters, large amounts of blood continue to be shunted to the periphery with cutaneous vasodilation in attempt to attenuate the rise of core temperature, and subsequent reductions in blood flow to some tissues result from lower blood volume in total, as the thermoregulatory and cardiovascular systems compete for less fluid.

Exercising heat stress in children

Many young athletes train and compete in conditions that place high demands on their body's thermoregulatory mechanisms, in particular high ambient and/or humid conditions. These environmental conditions, coupled with metabolic costs of exercise, can place children at risk for fluid imbalance (i.e. perturbations in body water content within the intra- and extracellular compartments, as well as whole-body electrolyte concentrations). Hypohydration, namely a decrease in whole-body water stores due to combined water and electrolyte losses in sweat, is usually the major health concern

during exercise in the heat, whereas hyperhydration is typically a less frequent concern. For the exercising adult, it has been well demonstrated that hypohydration per se can increase skin and core temperature (Cheuvront et al., 2003; Inbar et al., 2004; Horswill et al., 2005), leading to increased cardiovascular strain, especially in the heat. Elevated heart rate and blood pressure during exercise can contribute to a number of physiologically deleterious effects, including: decreased physical performance (primarily during endurance exercise), increased fatigue and the perception of effort, decreased motivation, coupled with increased propensity for injury, including both musculoskeletal and total heat illness (Sawka et al., 2007; Horswill et al., 2005; Sawka et al., 1998; Meyer et al., 1992).

In prepubescent children, there is still a question of the extent to which hypohydration directly contributes to these stressors. Indeed, compared to adults, prepubescent children experience greater proportional increases in core and skin temperatures as they become dehydrated (Inbar et al., 2004; Falk et al., 2008; Meyer et al., 2012). Although heat acclimatization can naturally occur with repeated exposure to hot environments throughout a hot summer season, heat acclimatization occurs more slowly in children (Inbar et al., 2004; Falk et al., 2008), possibly predisposing them to overt heat illness(es). Factors which contribute to increased thermal strain in children include: a lower sweat rate and a higher metabolic cost of locomotion (to such extent that there is more heat produced and less dissipated for a given activity), in addition to a higher surface area to body mass ratio. Finally, there is an emerging concern of an increased possibility of hyponatremia in active children, especially in the view of the popular "drink lots of water" recommendation(s) espoused in the popular literature. Clinically, hyponatremia is defined as a serum sodium level of <135mEq L^{-1}, which includes a rapid lowering of blood sodium. Note that blood sodium concentrations usually rest between ~140-145 mEq L^{-1}; thus, with the rapid ingestion of plain water, blood sodium dilution is a technical, if not rare, possibility for exercising children.

Table 1: Overview of the studies (N = 12) which include pre-pubertal child populations, and an exercise/or a hydration component to their experimental investigations.

Study	Sample Population	Study Intervention	Main Study Outcome(s)
Bergeron, MF et al, 2009	N = 24 athletes (age 12 −13, N = 6 boys, N = 6 girls, and age 14 - 16 y, N = 6 boys, N = 6 girls)	Two 80-min intermittent exercise bouts (treadmill 60 %, cycle 40 % peak oxygen uptake) in 33° C, 49 % relative humidity	Sweat loss, core temperature, physiological strain index and thermal sensation were not different between either age groups or between girls/boys. RPE higher in 16 − 17 y group on exercise bout 2 compared to bout 1. One-h rest between bouts with hydration matched to mass loss was adequate recovery for second exercise bout.
Hewitt, MJ et al 1993	N = 28 healthy children (5 − 10 y), N = 31 young adults (22 − 39 y), N = 62 older adults (65 − 84 y)	Determination of water : FFM via $2H_2O$ dilution method and Siri 2-component modelling	Prepubescent children (72.7 +/- 1.6 %) and older adults (72.5 +/- 1.4 %) have significantly higher ($P < 0.01$) mean W/FFM than young adults (70.8 +/- 1.2 %).
Hill et al, 2008	Rest and exercise groups	Comparison of 3 sports drinks with water [rest + exercise (55 % max HR on treadmill)] using deuterium dilution technique. Rest = 0.05g/kg of deuterium (gelatine capsules), saliva samples collected every 5 min for 1 h. kinetics modelled to derive hydration data.	NS differences in max absorption rate at rest or by the end of exercise; concluded that the sports drinks studied did not hydrate the body at a faster rate compared to water.
Kavouras et al, 2012	N = 92 children (age 13.8 ± 1.2 y), N = 31 control (N = 13 boys,18 girls) N = 61 intervention (INT) (N = 30 boys, 31 girls)	Educational intervention in schools where the intervention group attended a lecture on hydration and urine colour charts placed in bathrooms	Hydration status (USG) improved from 1.031 to 1.023 in INT group. Endurance run time for 600 m distance improved in INT group only (from 189 to 167 s)

Study	Sample Population	Study Intervention	Main Study Outcome(s)
Rivera-Brown et al, 2008	N = 12 trained, heat-acclimatized girls (11 y)	Three 3-h sessions of four 20-min cycling bouts (60 % $\dot{V}O_{2peak}$), alternating w 25 min rest. One of three beverages (ad libitum): unflavored water (W), flavored water (FW) or flavored water plus 6 % carbohydrate and 18 mmol/l NaCl (CNa).	Sweat loss, HR, rectal temperature not different between trials; urine produced was 73 and 68% lower [corrected] during CNa compared to [corrected] FW and W (W = 269.8 +/- 85.9; FW = 320.8 +/- 87.2; CNa = 85.6 +/- 9.3 g). Flavoured water and 6 % CHO + 18 mmol/l NaCl do not prevent mild hypohydration
Riviera-Brown et al, 1999	N = 12 trained, heat-acclimatized boys (13 y)	Two 3-h exercise sessions of four 20 min cycling at 60 % $\dot{V}O_{2peak}$, alternating 25 min rest. One of two beverages was assigned: unflavored water (W) or flavored water plus 6 % CHO and 18 mmol/l Na (CNa) ad libitum.	Total intake was higher with CNa (1,943 6 190 g) v W (1,470 6 143 g). Euhydration was maintained with CNa; mild dehydration with W. Flavored CHO-electrolyte drink prevents voluntary dehydration in boys exercising in the heat despite sweat losses.
Rowland et al, 2008	N = 8 boys, Tanner stage 11 y	Cycle at 63 % $\dot{V}O_{2peak}$ to exhaustion (~41 min) in a thermoneutral environment to characterize cardiovascular drift	Rectal temperature (fm 37.6° C to 38.1° C. HR +13 %, Q +15 %, systemic vascular resistance fell by 10.5 %, SV remained stable. Concluded that similar pattern of CV strain as adult men.
Rowland et al, 2007	N = 8 healthy non-acclimatized, highly physically active prepubertal boys	Steady-load cycling [65 % $\dot{V}O_{2peak}$ to exhaustion in cool (20°C, 66 % rh) and hot (31° C, 57 % rh)	Endurance time significantly shorter in the heat (29 ± 6 v 41 ± 6 min). NS in circulatory markers, hydration status or RPE between conditions. Rate of rise of Tre greater in the heat, but NS in Tre at exhaustion. Authors argue that rises in core temperature and/or brain perception (RPE) rather than circulatory insufficiency may be the critical factors defining limits to exercise in the heat for prepubertal boys.
Wang, S et al 2013	N = 102 (age 5 −60 y) divided into 5 groups	Exercise-induced sweating on facial sebum, changes in skin surface pH at rest, beginning of sweating, excessive sweating and 1-h post sweating	Excessive sweat from exercise did not impair the surface pH of facial skin; no consequential differences between age groups
Wilk et al, 2007	N = 12 physically active girls (9 − 12 y)	Assess the influence of drink flavor and composition on voluntary drinking and hydration status in girls; exercise intermittently in the heat (35° C , 45 − 50 % rh)	Difference in body mass between water (-0.15 %) and grape-flavored water +6 % CHO, and 18 mmol l NaCl trial (-0.45 %); NS between any other physiological or psychophysical variable between trials. Euhydration maintained by adequate intake of unflavored water.

Study	Sample Population	Study Intervention	Main Study Outcome(s)
Wilk et al, 1998	N = 12 healthy boys (10 − 12 y)	Six 70-min intermittent exercise sessions [three 20-min cycling (50 % $\dot{V}O_{2peak}$ 5 min rest in between)] at 35° C, 50 % or 60 % rh.	NS between the six sessions in: drink intake (765 − 902 g), hydration level (+0.75 to +1.07 % BM), sweat rate (245 − 263 $g.m^{-2}.hr^{-1}$), all other physiological + perceptual variables. Grape-flavored CHO-NaCl beverage sufficient to prevent dehydration during repeated exercise in the heat.
Wilk & Bar-Or, 1996	N = 12 boys (9-12 y)	Three 3-h sessions [four 20 min cycling (50 % VO2, followed by 25-min rest) in 30° C , 45 − 50 % rh]. One of three beverages (Latin-square sequence): unflavored water (W), grape-flavored water (FW), and grape-flavored water plus 6 % CHO + 18 mmol/l NaCl (CNa).	NS between trils in BM, HR, rectal and skin temperatures, thirst, stomach fullness; hypohydration seen with W (-0.65 % BM) and FW (-0.32 % BM), and CNa = slight overhydration (+0.47 % BM).

Notes: BM, body mass; CHO, carbohydrate; CV, cardiovascular; FFM, fat-free mass; HR, heart rate; NS, no significance; RH, relative humidity; RPE, ratings of perceived exertion; USG, urine specific gravity; VO_{2peak}, aerobic capacity; y, years.

CURRENT HYDRATION PRACTICES IN EXERCISING CHILDREN

The clinical paediatrics profession and the World Health Organisation (WHO) each have specific recommendations addressing rehydration/hydration strategies for combating illness-induced dehydration which are defined as body water losses > 4 % (Bergeron et al., 2011; Popkin et al., 2010), but there are no such recommendations for exercise-induced body water losses of <3 %. The majority of body water losses seen during active play and even intense physical activity in children rarely exceeds 3 % of the total body mass. To address this concern, the scientific and medical literature recently published guidelines to describe what and how much an active, pre-pubescent child should drink (Bergeron et al., 2011), although it is admittedly difficult to formulate a single hydration guideline which can encompass all young athletes. Relative to their body size, children demonstrate less total sweat water and sodium losses during exercise than adults (0.25 – 0.65L h^{-1} and 0.19-0.27 g h^{-1} Na^+ loss vs 1.5-3.0L h^{-1} and 0.8-4.0 g h^{-1} Na^+ loss, in children vs. adults, respectively) (Meyer et al., 1992; Meyer et al., 2012).

Although the percentage levels of incurred dehydration are similar in pre- and post-pubertal athletes, there are differences in levels of hypohydration and subsequent per-

formance decrements in children. For example, a 2 % or greater body mass loss in adults can result in significant, measurable decreases in aerobic and muscular performance (Cheuvront et al., 2003; Sawka & Noakes, 2007), whereas only a 1 % loss in pre-pubertal children has been shown to elicit similar performance decrements (Meyer et al., 2012). In contrast to adults, if children are given adequate opportunity to drink during exercise, the fluid volume intake driven by thirst alone is expected to prevent significant levels of dehydration in the young athlete. This is primarily due to the children's lower sweat rates compared to their adult counterparts (Falk & Dotan, 2008; Meyer et al., 1992). Required fluid intake for children during exercise training can be conservatively calculated as an hourly fluid intake volume of 13 mL/kg bodyweight (Rowland, 2011).

Equally important is post-exercise fluid replenishment (approximately 4 mL/kg) for each hour of the completed exercise. This rehydration strategy would avoid initiating subsequent exercise bouts in a dehydrated state (Rowland, 2011; Unnithan et al., 2004). Given the above-mentioned factors differentiating young athletes from their adult counterparts (less sweat-sodium and fluid losses during activity, concomitant lower body mass loss impacting performance), additional research into the composition of hydration products and optimal fluid ingestion strategies are needed.

THE HYDRATION − COGNITION LINK

The effect of hypohydration in the paediatric *athletic* population has not been well studied. It is well documented that hypohydration is associated with disruptions in mood and cognition, in both adults and non-athletic children. Specifically, alterations in concentration, alertness and short-term memory, and psychomotor skills are observed. Cognitive and reaction abilities (in addition to physical conditioning) can significantly affect performance outcomes in both game and team sport situations. When examining the relationship between cognition and the impact hypohydration may have on young athletes' performance, the evidence appears to be equivocal. Edmonds and Burford (2009) observed children (7 to 9 year old boys) who were randomly allocated into two groups; an experimental group that received additional water (211.7 ± 62 ml) 20 min prior to cognitive testing, and a control group, which received no additional water. The group given additional water showed improvements in visual attention, although visual memory was unaffected. In research described by Benton and Burgess (2009), memory performance was improved by provision of water, but sustained attention was not altered in the same group of children. Bar-David et al. (2005) observed children (10 to 12 years old) who were identified as either euhydrated or dehydrated in the morning of testing. Regardless of hydration status, results from the cognition tasks were not significantly different between groups. However, by midday, the euhydrated group did perform significantly better on short-term memory, verbal analogy and visual attention tasks than the (initially) dehydrated group. Moreover, Fadda et al. (2012) also observed

significant improvements in short-term memory in 9 to 10 year old children who were provided 1000 ml supplementary water throughout the school day. Taken together, these results indicate a connection between hydration status and cognitive function abilities in children, especially throughout the school day, and that giving children an opportunity to drink may enhance certain cognitive abilities, including but not limited to: short-term memory, visual attention, verbal analogy, and perhaps visual memory.

The possibility exists that children are particularly susceptible to hypohydration due to inadequate fluid intake, given their large surface area to volume ratio, and higher levels of activity and immature thirst mechanisms. For example, one study asked 10 to 12 year olds to cycle in 39° C; in one trial they drank when they were thirsty, whilst in the second trial they drank enough water to replace fluid losses. It was only when drinking to thirst that the children became progressively dehydrated (Bar-Or et al., 1980), data which was consistent to the theory that children's thirst mechanisms are not being fully operational at this age (Kenney & Chiu, 2001). Indeed, drinking attitudes and the amount of fluid active children ingest are influenced by a number of factors, primarily: sport modality, the type of competition, practice duration, fluid availability, and the characteristics (flavour, temperature) of the beverage available (Broad et al., 1996; Meyer et al., 1994; Rivera-Brown et al, 1999). As the aforementioned factors can influence the hydration practices of the pre-pubescent athlete, sufficient and appropriate fluid should be provided on-site (with education around hydration status), and children should be encouraged to create appropriate hydration strategies with their coaches encompassing before, during and after sporting activity to promote euhydration and overall fluid balance in young athletes.

REFLECTIONS AND RECOMMENDATIONS

We chose to examine a "snap-shot" of the current literature regarding exercising children, heat stress and hydration practices. Although this work used a semi-systematic approach, utilising one major electronic search engine, we believe this method was robust enough to reveal a paucity of research data in the sport science child-hydration field in general, and a lack of experimental data in particular within this population.

CONCLUSIONS

A greater focus on children's hydration status and specific hydration requirements for peak performance (either for physical or cognitive development) is a research area with a dearth of high-quality, peer-reviewed experimental investigations. In contrast to adults, if children are given adequate opportunity to drink during exercise, the fluid volume intake driven by thirst alone is expected to prevent significant levels of dehy-

dration in the young athlete. This is primarily due to the children's lower sweat rates compared to their adult counterparts.

Acknowledgements and Disclosures

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COGNITIVE AND PHYSIOLOGICAL INITIAL RESPONSES DURING COOL WATER IMMERSION

Alex BUOITE STELLA[1], Cornelius Peter BOGERD[2]

[1] University of Udine, Department of Medical and Biological Sciences, Italy
[2]TNO, the Netherlands

Corresponding author:
Alex BUOITE STELLA
University of Udine, Department of Medical and Biological Sciences, Italy
e-mail: alex.buoitestella@aol.com

ABSTRACT

The initial responses during water immersion are the first mechanisms reacting to a strong stimulation of superficial nervous cold receptors. Cold shock induces tachycardia, hypertension, tachypnea, hyperventilation, and reduced end-tidal carbon dioxide fraction. These initial responses are observed immediately after the immersion, they last for about 3 min and have been also reported in water temperatures up to 25 °C. the aim of the present study was to observe cognitive and physiological functions during immersion in water at cool temperature. Oxygen consumption, ventilation, respiratory frequency, heart rate and expired fraction of oxygen were measured during the experiment. A code substitution test was used to evaluate executive functions and, specifically, working memory. This cognitive test was repeated consecutively 6 times, for a total duration of 5 minutes. Healthy volunteers (n = 9) performed the test twice in a random order, once in a dry thermoneutral environment and once while immersed head-out in 18 °C water. The results indicated that all the physiological parameters were increased during cool water immersion when compared with the dry thermoneutral condition ($p < 0.05$). Cognitive performance was reduced during the cool water immersion when compared to the control condition only during the first 2 min ($p < 0.05$). Our results suggest that planning the best rescue strategy could be partially impaired not only because of panic, but also because of the cold shock.

Keywords: *cool water immersion, hyperventilation, cold shock, cognitive responses, sea survival*

ZAČETNI KOGNITIVNI IN FIZIOLOŠKI ODZIVI MED POTOPITVIJO V HLADNO VODO

POVZETEK

Med potopitvijo v vodo se začetni odzivi najprej pokažejo kot reakcija na močno stimulacijo površinskih živčnih receptorjev na mraz. Ta stres zaradi mraza sproži tahikardijo, hipertenzijo, tahipnejo, hiperventilacijo in zmanjšan delež ogljikovega dioksida v izdihanem zraku. Takšne začetne odzive zaznamo nemudoma po potopitvi, trajajo približno 3 minute, zaznani pa so bili tudi pri temperaturi vode vse do 25 °C. Cilj pričujoče študije je bil opazovati kognitivne in fiziološke funkcije med potapljanjem v hladni vodi. Med poskusom so bili izmerjeni poraba kisika, dihanje, respiratorna frekvenca, frekvenca srčnega utripa in delež kisika v izdihanem zraku. Za oceno eksekutivne funkcije in predvsem delovnega spomina je bil uporabljen test kodiranja (angl. code substitution test). Ta kognitivni poskus je bil 6-krat zaporedoma ponovljen, v skupnem trajanju 5 minut. Zdravi prostovoljci (n = 9) so bili testirani dvakrat, v naključnem zaporedju, enkrat v suhem, termonevtralnem okolju in enkrat potopljeni v vodi s temperaturo 18 °C z glavami nad vodno površino. Rezultati so pokazali, da so bili v primeru potopitve v hladno vodo povečani vsi fiziološki parametri v primerjavi s stanjem v suhih termonevtralnih pogojih (p < 0,05). V primerjavi s kontrolnim testiranjem se je kognitivna zmogljivost pri potopitvi v hladno vodo zmanjšala le v prvih 2 minutah (p < 0,05). Rezultati kažejo, da bi bilo načrtovanje najboljše reševalne strategije lahko delno poslabšano zaradi panike in tudi stresa zaradi mraza.

Ključne besede: *potapljanje v hladno vodo, hiperventilacija, stres zaradi mraza, kognitivni odzivi, preživetje v morju*

INTRODUCTION

Between 1978 and 1998 more than 5,300 passengers were killed in ferry accidents around the world, and this made ferry travel 10 times more dangerous than air travel (Faith, 1998). Water temperature is a fundamental factor when analyzing sea survival. The sea surface temperature measured at a 4-metre depth (SST) of the Mediterranean is warmer than in the ocean and in the water surrounding Northern Europe. For the Western Mediterranean, in 2006 the SST annual mean was about 19 °C, while for the Eastern Mediterranean it was about 21 °C, with oscillations in winter and summer of ± 4 °C (Nykjaer, 2009). In contrast, SST of the North Sea reaches 6 °C in winter and 21 °C in summer. With an estimated mean of about 15 °C this means that falling into water likely leads to death due to swimming failure or hypothermia (Golden & Tipton, 2002). Timing is a relevant factor influencing the physiological responses and the rescue ex-

perts have always to consider it. Nowadays, with statistical analysis and the improvement of Search and Rescue activities, the main identified risk is drowning, especially if the sea is not calm (Golden & Tipton, 2002). Thus, even early stages of immersion could lead to death because of inability to swim and drowning, while the immersion in cold water for a prolonged time induces organs failure caused by hypothermia (Golden & Tipton, 2002). In 1981, Golden and Harvey identified four stages of immersion being associated with specific risks, resulting in specific protocols for each stage to help Search and Rescue activities: (i) initial responses, (ii) short-term responses, (iii) long-term responses and (iv) post-immersion responses. In this work a greater attention was put on the initial responses. After the immersion in cool water, cold receptors in the skin are strongly stimulated and provoke several physiological responses which include tachycardia, hyperventilation, tachypnea and hypertension (Datta & Tipton, 2006). Each response can adversely affect survival chances and can reduce physical and psychological performances (Cheung, 2010). Physiological responses start immediately after the immersion; their intensity is inversely proportional to water temperature and directly proportional to the body area surrounded by water (Golden & Tipton, 2002). The peak is reached 30 seconds after the immersion and physiological parameters return to normal values in about 3 minutes (Datta & Tipton, 2006). Since these responses are not observed in warm water, this indicates that there is a neurogenic origin driven by cold receptors located below the skin surface (Datta & Tipton, 2006). Indeed, the initial responses are stimulated through superficial subepidermal cold receptors (Datta & Tipton, 2006). Afferent pathways responsible for the respiratory responses (hyperventilation, increased respiratory frequency, etc.) are likely to be directly mediated by the midbrain (Keatinge & Nadel, 1965). Fat mass helps increasing survival time reducing core cooling rate but does not have preventive effects on the initial responses. Clothing plays a key role in determining the magnitude of the initial responses. Significant differences in the physiological responses between participants wearing only swim trunks or other kind of clothing have been reported (Tipton, Stubbs & Elliot, 1990). One of the most threatening situations occurs if the subjects, when initial responses are present, submerge their faces into the water (Tipton, 1989). Breath-holding maximum time is reduced because of hyperventilation and the conflict between the vagal and the sympathetic systems caused by the immersion reflex can provoke arrhythmias (Datta & Tipton, 2006). Thus, the initial responses which primarily affect cardiorespiratory functions, are likely to be responsible for the majority of near-drowning incidents and drowning deaths following accidental immersion in open water below 15 °C. The main physiological consequences of cool water immersion observed in the literature are summarized in figure 1.

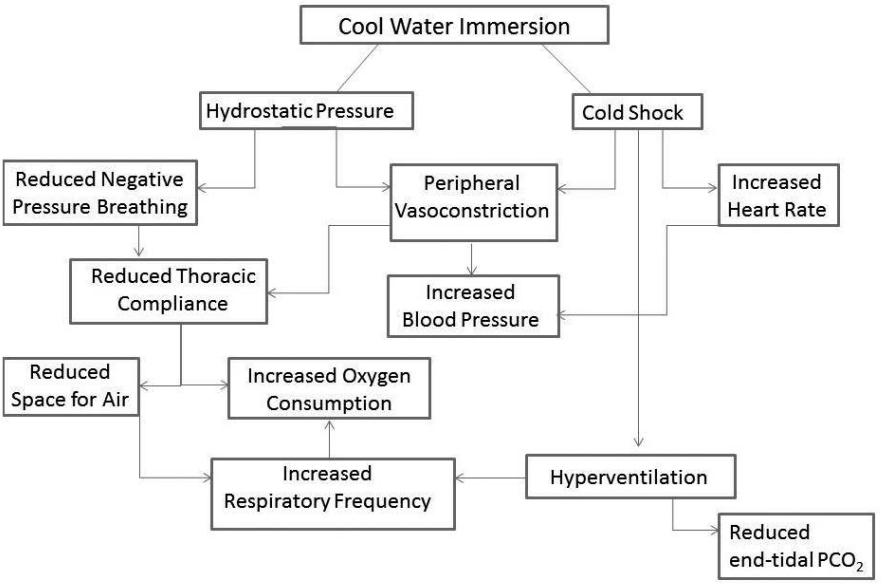

Figure 1: Physiological effects of cool water immersion.

Several studies (Lounsbury, 2004; Ducharme & Lounsbury 2007; Cheung, 2010) observed the timeline for self-rescue, evaluating the factors like the time needed to reach a critical low core temperature while immersed into the water or the maximal distance that a survivor can swim while wearing normal clothing in cold or cool water. All these studies concluded that one of the biggest challenges in the initial phases of survival scenarios is taking the best decision, like "stay or swim" (Lounsbury, 2004; Ducharme & Lounsbury, 2007; Cheung, 2010). As discussed above, during the initial responses physiological functions are altered and physical reactions are potentially detrimental for the possibilities of rescue. These results suggest that immediately after the immersion, mental performance and visual functions could be reduced. Thus, working memory could be negatively affected during a sea survival scenario. Acute cold exposure in the air (10 °C) declined working memory, choice reaction time and generally the executive function, compared to baseline performance (Muller et al., 2012). Conversely, another study assessed that low demanding cognitive performances are unaffected by cold, whereas high demanding tasks were reduced only with decreasing core temperature and not during the initial phase (Giesbrecht et al., 1993). Using the conditional discrimination task, however, response accuracy was impaired even with moderate cold exposure without core hypothermia (Thomas et al., 1989). The hypothesis of a reduced cognition caused by the initial responses is suggested also by the reduced total and oxygenated hemoglobin in the frontal area during hyperventilation,

measured by multi-channel near-infrared spectroscopy (Watanabe et al., 2003). Blood pressure is evenly raised during the initial responses and this can influence executive functions. Indeed, cognitive performance is inversely correlated to resting blood pressure also in young healthy adults (Suhr, Stewart and France, 2004).

The aim of the present study was to evaluate the initial physiological and cognitive responses during the first minutes after cool water immersion, proposing some "new knowledge" for the psychological effects. In particular, we want to observe the main physiological parameters such as heart rate and ventilation, and executive functions estimated through the symbol digit modalities test, immediately after the immersion and its behavior during the adaptation time. Our hypothesis was that during cool water immersion (18 °C) initial responses are observed and cognitive functions are partially impaired.

METHODS

Participants

Nine healthy young males (26.7 ± 4.4 years) participated in the study. All the participants participated voluntarily and were randomly recruited among university students or researchers, age between 18 and 35. None of them were smokers. Prior to participation, they were all instructed about the protocol and the aim of the study. Prior to participation, they were also informed about the possible risks of the study and they signed an informed consent. A physician assessed their health status. If they had an electrocardiography of their previous year, they were asked to send it to the physician for further analysis. Exclusion criteria were cardiovascular, respiratory or neurological diseases, hypertension, Raynaud syndrome, BMI higher than 30 kg/m^2. The protocol was approved by the University ethical committee.

The protocol

A week before the first experimental session, the participants received a training copy of the symbol digit modalities test (SDMT) in order to become confident with the cognitive test. Participants were instructed about the experimental protocol and before the measurements were carried out, they confirmed they became confident with the cognitive test. Control condition (CON) was performed in a dry thermoneutral environment (25.6 ± 0.9 °C), while an experimental condition (EXP) was performed while they were immersed head-out in 18 °C water. Both conditions were performed at rest and at least two hours after they woke up to avoid sleep inertia. In order to avoid learning effects, a cross-over designed study was carried out with all 9 participants undergoing

both conditions in a randomized sequence. No alcohol, coffee, tobacco or carbohydrates were consumed at least 1 hour before the measurements. For EXP, the participants were asked to come to the pool 60 minutes before the start of the measurements in order to acclimatise to the environment (26.5 ± 1.1 °C). During the acclimatisaton and the experimental protocol they wore only short swimming trunks. Body mass, height, and body fat were measured. Just before the immersion, physiological parameters were recorded at rest for 5 min (rest phase, R) and immediately afterwards the participants completed the warm-up of the SDMT. The participants then entered in the pool filled with cool water (18.5 ± 0.4 °C), head-out with water reaching the collarbone. They remained in the water for 5 min, during which six steps of 45 s (step I, II, III, IV, V, VI) were used to average their physiological responses, each step with 5 s of pause. Each period corresponded also to a different sheet of the SDMT. Overall, for every period we obtained a cognitive performance score and a correspondent physiological response for all the parameters measured. Figure 2 describes the measurements protocol.

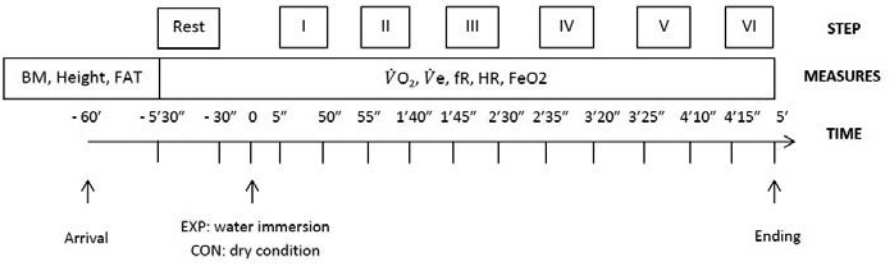

Figure 2: Protocol timeline for both conditions (CON; EXP), indicating different times, measures and steps. For each step a SDMT sheet was used and analyzed.

The measurements

Water and air temperature

A water specific analogic thermometer with a mercury column was used to assess water temperature during all the measurements. The thermometer was completely immersed into the water during the measurements and temperature was recorded at the beginning and at the end of participants' immersion. The two results were averaged and presented. Air temperature was measured with a digital thermometer for outdoor activities (Rocktrail IAN 58787, Bedfordshire, UK).

Physiological Parameters

A metabolic cart (Fitmate Plus, Cosmed Srl, Italy) was used to measure physiological functions a device which automatically calibrates itself before every use, sampling air from the environment. Heart rate (HR, bpm) was continuously recorded through a Polar belt (Polar, Sweden) connected with a wireless receiver on the metabolic cart. Ventilation ($\dot{V}e$, L/min), oxygen consumption ($\dot{V}O_2$, $mlO_2/kg*min$), respiratory frequency (fR, 1/min) and the expired fraction of oxygen (FeO_2, %) were analyzed and measured by the metabolic cart continuously. Body mass (kg), height (m) and body fat (FAT, %) were measured before the immersion. FAT was measured by using a bioimpedance device according to device's guidelines (Handy3000, DS Medica Srl, Italy).

Cognitive Performance

The Symbol Digit Modalities Test (SDMT), a code substitution test, is a reliable and repeatable method used in neuropsychology to assess information processing speed, selective attention and working memory (Nocentini et al., 2006). This test consists of a sheet of paper with a matrix of nine symbols and nine corresponding numbers at the top. An example of the SDMT matrix used in this study is illustrated in figure 3.

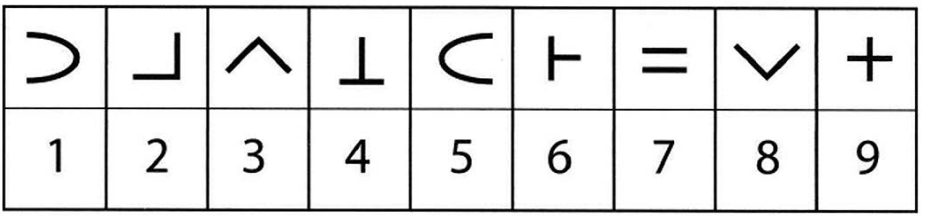

Figure 3: An example of a SDMT matrix from Nocentini et al., 2006.

In the same sheet, below the matrix, there is a sequence of symbols with a blank square where participants have to write the corresponding number using the matrix at the top, as fast as possible. The common protocol consists of matching a maximum of 110 symbols in 90 seconds. The test can be proposed in both written and oral versions, the written protocol can be influenced by manual dexterity and coordination (Nocentini et al., 2006). This kind of test is widely used in clinical settings to assess cognitive functions in patients with dementia or other neurological diseases. However, it has been used also in experimental studies observing the environmental effects on mental performance (Suhr, Stewart, & France, 2004; Hodgdon et al., 1991; Wright, Huli, & Czesler, 2002, Pepper et al., 1985). In the present study the time was halved (45 s per every sheet instead of 90 s) in order to increase the temporal resolution. To perform the SDMT, a sheet of paper having on the top a matrix with 9 different symbols and their corresponding numbers, from 1 to 9, were printed on a sheet of paper. Below the

matrix, there was a sequence of 55 symbols for which participants had to match the corresponding number; a blank square at the side of each symbol allowed researchers to record the corresponding number indicated by the participant. The participants could look at the matrix during the whole execution of the measurement session. After an initial warm-up in which they filled out a line with 10 symbols without any time pressure, the test started. Participants had 45 s to match as many symbols as they could with a maximum of 55 symbols for each sheet. After 45 s a different sheet showing a different matrix and a different 55 symbols sequence was provided to the participants. The measurements started 5 s after the participants were immersed and changed every 45 s with 5 s of pause after each step for 5 min. One experimenter showed the sheet of the SDMT to the participant, while another experimenter recorded the results on a different copy of the same sheet. Results have been recorded for every different step in order to obtain a temporal evaluation of the cognitive performance. None of the participants completed the entire symbol sequence. The SDMT score (i.e., the number of correct combinations symbol-number) and the number of errors they committed during the test were recorded.

Calculations and data analysis

Body surface area (BSA, m^2) was calculated through body mass and height with the Du Bois and Du Bois equation (1916). Heart rate (HR), ventilation ($\dot{V}e$), respiratory frequency (fR), oxygen consumption ($\dot{V}O_2$) and oxygen expired fraction (FeO_2) were recorded and displayed by the metabolic cart. A gas mixing chamber inside the metabolic cart collected expired gases and the software averaged the results every 15 s. Heart rate increment was calculated as a percentage of the maximal heart rate, estimated with Tanaka's equation (2001), HR_{MAX} (bpm) = 208–0.7*age (yrs). During the analysis, physiological responses have been averaged in order to obtain steps of 45 s. Physiological and psychological responses are expressed as mean ± standard deviation. Differences between conditions were considered positive if EXP values were greater than CON. Repeated measures ANOVA were used to depict difference among conditions and between the steps within the same condition. P-values lower than 0.05 are considered significantly different. A t-test with a Bonferroni corrected p-value was used for post-hoc comparison. Correlation analysis (Pearson's coefficient) was performed between cognitive performance and physiological responses. All statistics were carried out with SPSS 19.0. We observed if there was any possible effect of the cognitive test on the physiological parameters or vice versa.

RESULTS

Characteristics of the participants

The participants' body mass was 76.3 ± 6.6 kg and their body mass index (BMI) was 23.9 ± 1.5 kg/m^2. Body fat was 16.8 ± 3 % of body mass. Body surface area (BSA) was 1.92 ± 0.11 m^2.

Physiological Parameters

Physiological values at rest did not differ statistically between conditions (CON and EXP), with a small difference only in the FeO_2, which was significantly higher in EXP (+ 0.51, $p < 0.05$).

During CON, the main physiological parameters, $\dot{V}O_2$, $\dot{V}e$ and FeO_2 were not significantly different among the different steps and rest. Conversely, fR increased significantly from rest to step 2 (+ 14.3 1/min, $p < 0.05$) and HR was significantly different from rest to step 1, step 4, step 5 and step 6 (respectively + 9.4, + 9.1, + 7.9, + 9.6, L/min $p < 0.05$ for all). During EXP, a statistical difference was observed for all the parameters, except for FeO_2. $\dot{V}O_2$ was significantly greater than rest only in step 1 (+ 7.2 mlO_2/kg*min, $p < 0.05$), and a similar behavior was observed for $\dot{V}e$ (+ 24.5 L/min, $p < 0.05$). fR was significantly greater than rest in step 1 (+ 23 1/min, $p < 0.01$), in step 2 (+ 18.6 1/min, $p < 0.01$) and in step 5 (+ 16 1/min, $p < 0.05$). HR was significantly increased only from rest in step 1 (+ 29.7 bpm, $p < 0.05$). Figures from 4 to 8 show the results of the different physiological parameters, comparing CON and EXP, throughout the experiment.

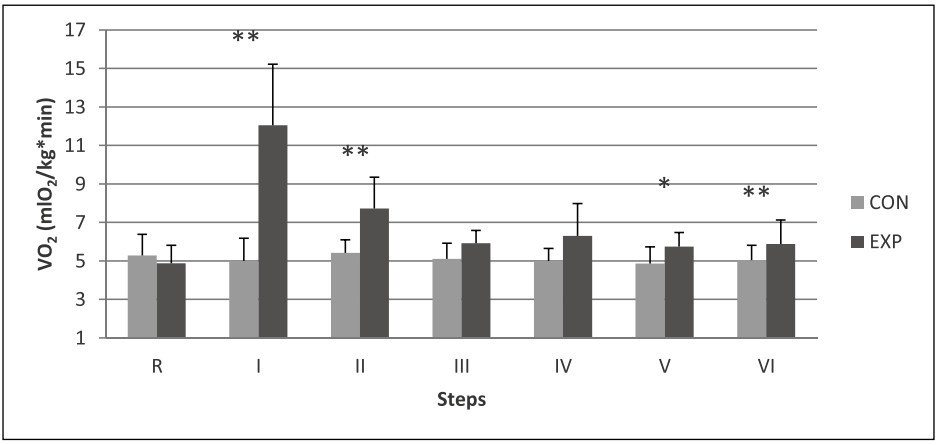

*Figure 4: Oxygen consumption ($\dot{V}VO_2$, mLO_2/kg*min) measured during CON (light grey) and EXP (dark grey). R (rest), roman numbers indicate different steps. Results are shown as mean ± SD. Significant difference between conditions are marked. * p < 0.05, ** p < 0.01.*

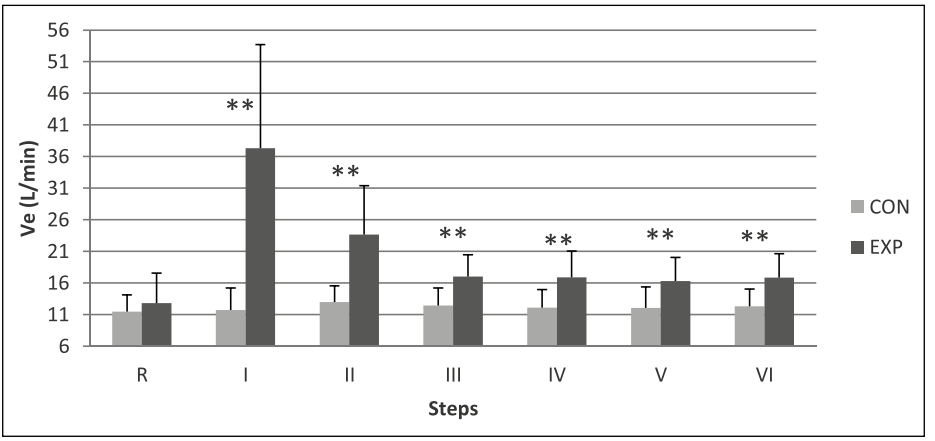

*Figure 5: Ventilation ($\dot{V}Ve$, L/min) measured during CON (light grey) and EXP (dark grey). R (rest), roman numbers indicate different steps. Results are shown as mean ± SD. Significant differences between the conditions are marked. * p < 0.05, ** p < 0.01.*

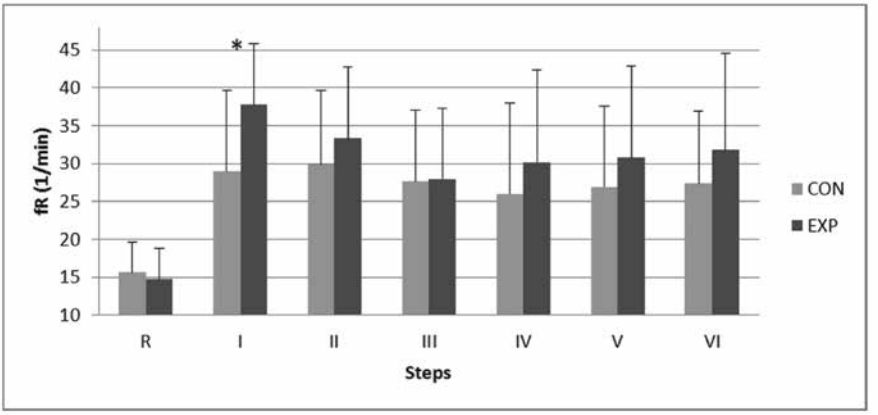

*Figure 6: Respiratory frequency (fR, 1/min) measured during CON (light grey) and EXP (dark grey). R (rest), roman numbers indicate different steps. Results are shown as mean ± SD. Significant differences between the conditions are marked. * $p < 0.05$, ** $p < 0.01$.*

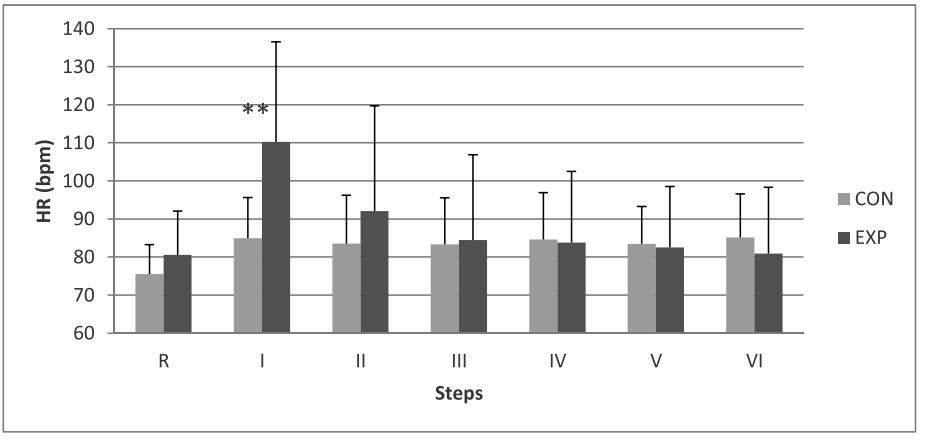

*Figure 7: Heart rate (HR, bpm) measured during CON (light grey) and EXP (dark grey). R (rest), roman numbers indicate different steps. Results are shown as mean ± SD. Significant differences between the conditions are marked. * $p < 0.05$, ** $p < 0.01$.*

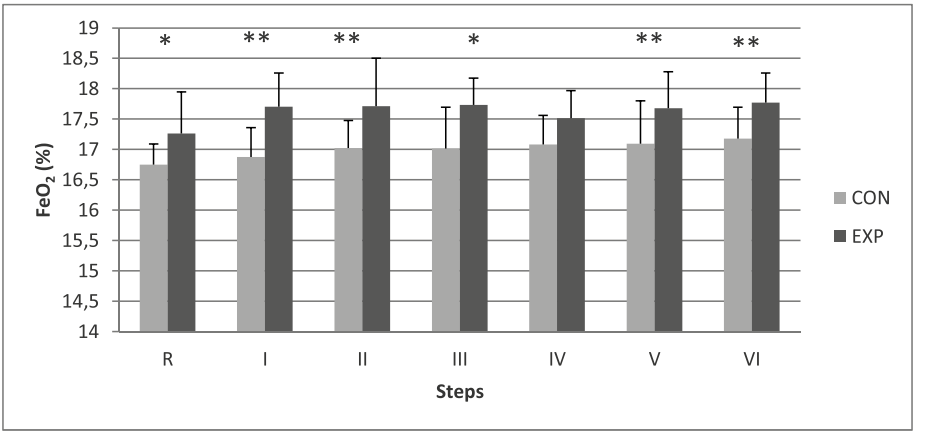

*Figure 8: Expired fraction of oxygen (FeO_2, %) measured during CON (light grey) and EXP (dark grey). R (rest), roman numbers indicate different steps. Results are shown as mean ± SD. Significant differences between the conditions are marked. * $p < 0.05$, ** $p < 0.01$.*

Considering the difference between the two conditions, step 1 was significantly different in all the physiological parameters. During EXP, $\dot{V}O_2$, $\dot{V}e$, fR, HR and FeO_2 showed an increase in their values, respectively + 7.05 mlO_2/kg*min ($p < 0.01$), + 25.6 L/min ($p < 0.01$), + 8.8 1/min ($p < 0.05$), + 25.2 bpm ($p < 0.01$) and + 0.8 % ($p < 0.01$). In step 2, there was a significant difference between CON and EXP in $\dot{V}O_2$ (+ 2.3 mlO_2/kg*min, $p < 0.01$), $\dot{V}e$ (+ 10.7 L/min, $p < 0.01$) and FeO_2 (+ 0.69 %, $p < 0.01$). Conversely, fR and HR were not statistically different between the two conditions. During step 3, only $\dot{V}e$ (+ 4.6 L/min, $p < 0.01$) and FeO_2 (+ 0.72 %, $p < 0.05$) were significantly different between the two conditions. In step 4, only $\dot{V}e$ was different between CON and EXP, being increased during immersion (+ 4.8 L/min, $p < 0.01$). Step 5 showed a significant difference between the two conditions in $\dot{V}O_2$ (+ 0.9 mlO_2/kg*min, $p < 0.05$), $\dot{V}e$ (+ 4.2 L/min, $p < 0.01$) and FeO_2 (+ 0.58 %, $p < 0.01$). In the last step (step 6), $\dot{V}O_2$ (+ 0.8 mlO_2/kg*min, $p < 0.01$), $\dot{V}e$ (+ 4.6 L/min, $p < 0.01$) and FeO_2 (+ 0.59 %, $p < 0.01$) remained significantly greater in EXP as compared to CON.

Cognitive Performance

In both CON and EXP no statistically significant difference was observed among the different steps in both the SDMT score and the number of errors. Comparing conditions, the score was lower in EXP in step 1 (36 ± 6 vs. 32 ± 7, - 4 points, $p < 0.05$) and step 2 (33 ± 4 vs. 30 ± 6, - 3 points, $p < 0.05$). The number of errors was not statistically different between conditions. Figure 9 illustrates the results for the SDMT score, comparing CON and EXP.

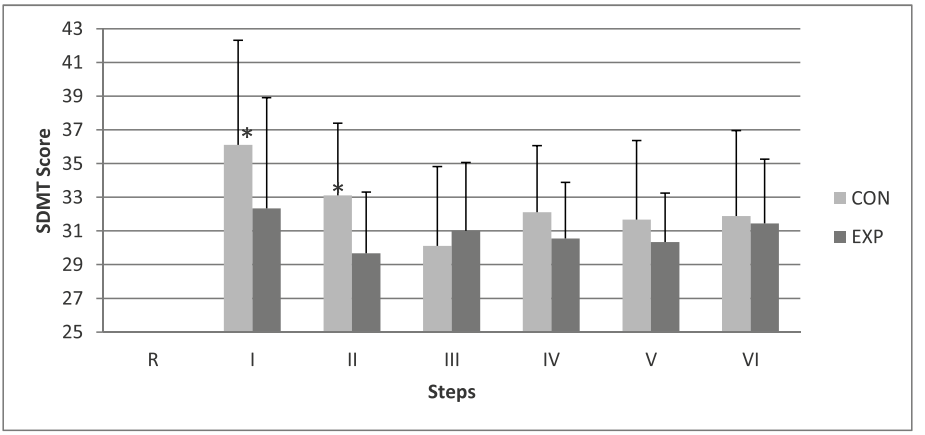

*Figure 9: SDMT score (number of correct answers) measured during CON (light grey) and EXP (dark grey). R (rest) is absent, roman numbers indicate different steps. Results are shown as mean ± SD. Significant differences between the conditions are marked. * $p < 0.05$, ** $p < 0.01$.*

No significant correlation could be detected between physiological parameters and cognitive performance (SDMT score), FeO_2 showing the strongest correlation with cognitive performance ($r = 0.563$, $p = 0.057$). Significant correlations were observed among physiological parameters, in particular between $\dot{V}$e and fR ($r = 0.919$, $p < 0.001$), $\dot{V}$e and FeO_2 ($r = 0.644$, $p < 0.05$) and fR and FeO2 ($r = 0.629$, $p < 0.05$).

DISCUSSION

Main findings

According to our work hypothesis, the results of the present investigation suggest the presence of physiological responses during the first minutes after cool water immersion at 18 °C. However, the amplitude and the duration of these responses are reduced if compared with colder water temperatures. Additionally, also cognitive functions seem to be negatively affected by cool water immersion, probably because of the detrimental influence of altered physiological parameters.

Rest values and SDMT effect

Results show that before performing the cognitive test, in both CON and EXP, participants' physiological parameters were similar to those expected while resting in orthostatism. To exclude the possible effect of the SDMT on the physiological parameters and the possible adaptation during the immersion, we observed the physiological responses through the different steps. Comparing the different steps in CON, it is possible to observe that HR was slightly increased during the cognitive test, but not in all the steps, the largest difference being found between the rest values and the first step (9.4 ± 1.9 bpm). fR was found increased only in step 2, but no interaction was found with the cognitive test. These results suggest that the execution of the SDMT did not alter the physiological responses.

Adaptation of physiological responses

In the literature (Datta & Tipton, 2006; Tipton, 1989), the initial responses after cold shock have been reported to last for about 3 min, with the peak reaching after 30 s and with progressive attenuation afterwards (Datta & Tipton, 2006; Golden & Tipton, 2002). The present study confirms the previous results, showing similar values in HR (- 6 bpm) and fR (+ 1 1/min) if the first step is compared with the first 30 s in 10 °C water reported by others. In the same comparison, $\dot{V}$e was higher (+ 28 L/min) in 10 °C water (Tipton et al., 2000). Also in 15 °C water $\dot{V}$e was higher (+ 17 L/min), while both HR and fR were similar to 18 °C water (respectively, + 4 bpm and -5 1/min) (Tipton et al., 1998). $\dot{V}O_2$, $\dot{V}$e and HR adapted fast, namely, already in the second step (i.e., after 45 s after immersion), since there was no significant difference between the rest values and the steps following the first one. FeO_2 was not different before or during immersion, while fR significantly increased in both step 1 and step 2. Thus, after about 2 minutes it was possible to observe an adaptation process also in the fR. In 18 °C

water, adaptation was slightly faster than the one observed in colder water, for example in 10 °C, exception made for fR. This trend was also observed while comparing 5 °C, 10 °C or 15 °C water temperatures (Tipton, Stubbs & Elliott, 1991; Tipton, Mekjavic & Eglin, 2000).

Cool Water Immersion

As reported in previous studies (Golden & Tipton, 2002), cool water immersion provokes different physiological responses in the organism. As shown in the present study, these responses are observed also in water at 18 °C. Comparing for each step the results of CON and EXP, it is possible to notice that all the parameters significantly increased during the first minute only in EXP. In step 1, $\dot{V}O_2$ was 153 % higher than its resting value, while $\dot{V}e$ was 200 % in most cases if compared to data prior to the immersion. fR showed the largest variation between the participants, probably because this parameter is related to anxiety and thus, maybe it depended also on participants' emotional status. HR during the first minute of immersion reached the 58 ± 14 % of the HR_{MAX}, estimated with Tanaka's equation (Tanaka, Monahan & Seals, 2001). Usually, this range of cardiac strain does not represent a risk also for the elderly or people with no severe heart diseases. However, in colder water the cardiac response could also increase HR (Friedman & Thayer, 1998) because of swimming and panic. As a consequence, combined with the effect of the hydrostatic pressure, systolic and diastolic blood pressure could rise even further and become a potential risk factor (Golden & Tipton, 2002). Acute hypertension could cause heart attack, stroke, acute pulmonary edema and, if aneurysms are present, blood vessels rupture with consequent hemorrhage (Tipton, 1989). The results show there was an adaptation process in all the physiological parameters during the immersion. However, some of them remained significantly increased if the same step was compared with CON. Hyperventilation decreased continuously step after step but was always significantly higher compared to $\dot{V}e$ in CON. Similar trends have been observed also in the $\dot{V}O_2$ and FeO_2. $\dot{V}O_2$ variation reflects the increased amount of energy required by the heart and respiratory muscles during the initial responses (Tipton, 1989). FeO_2 changes are related to changes in tidal volume as a consequence of the ratio between minute ventilation and respiratory frequency. As reported in the literature, the increased $\dot{V}e$ is one of the main hazards during a sea survival situation, decreasing maximal breath-hold time and increasing the chances to ingest also a small but potentially lethal quantity of water (Cheung, 2010; Datta & Tipton, 2006; Golden & Tipton, 2002). Increased HR and $\dot{V}e$ are consequences of the hydrostatic pressure and are worsened by cold temperature (Datta & Tipton, 2006). Thus, also with water temperature, common in large parts of the seas, as we observed in our study, initial responses could reduce survival chances.

Cognitive response

The score obtained by the SDMT differed substantially from participant to participant, indicating different information processing speeds. Thus, we reported a relevant variability in the cognitive response and this probably affected the statistics. Cognitive performance did not change significantly during the execution of the SDMT both in CON and EXP. Additionally, it can be a good method to evaluate temporal changes in the cognitive performance. Comparing SDMT score between conditions, we observed a significant difference only in the first two steps. Cognitive performance was reduced during the first two minutes of cool water immersion if compared with the same steps in the thermoneutral dry environment. Two participants out of nine performed better during the first step after the immersion, compared to CON, while in step 2 only one participant showed a better result in the water. As noticed before, the large variation among the participants reduced the mean difference between conditions, as illustrated in figure 10.

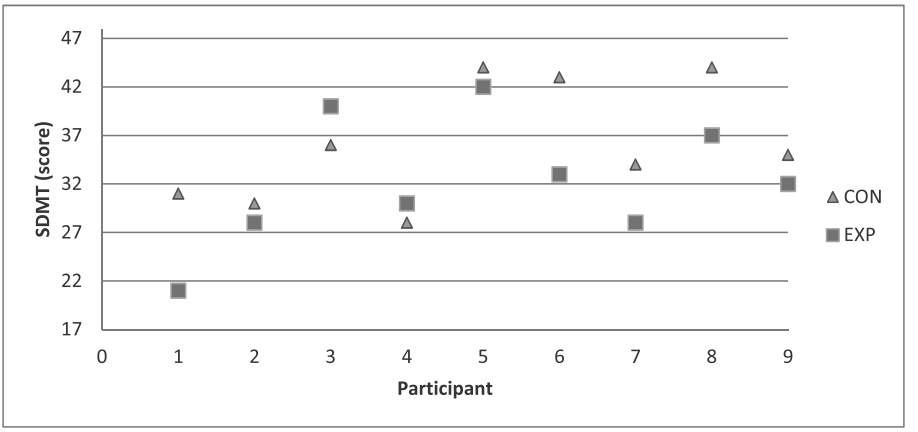

Figure 10: SDMT score (number of correct answers) measured during CON (light grey triangles) and EXP (dark grey squares) for each participant during the first step. Two participants had a better score in EXP than in CON.

The difference observed in four participants is relevant for assuming a reduced information processing speed when immersed in cool water. The number of errors was not relevant in this study; indeed, whenever the participants matched the wrong number they immediately corrected it by themselves. There was no difference in both time sequence and condition, with maximum one error in one sheet. Even if there was not

a significant correlation between SDMT score and physiological responses, the results of the present study suggest that cognitive performance is slightly impaired during the first minutes after cool water immersion. As shown in a different study, hyperventilation reduces the volume of oxygenated hemoglobin in the prefrontal cortex, while a cognitive performance requires a higher perfusion in the same area (Watanabe et al., 2003). Thus, hyperventilation could impair executive functions because of cerebral hypoxia (Tipton, 1989). In this study it was not possible to determine if the effects of hyperventilation were at the basis of the observed impairment. Another hypothesis is that the new environment and the immediate cold shock could slow information processing because the subject feels confused and distracted by the cold sensation on the skin. In a potentially hazardous situation, like a shipwreck, this physiological effect combined with fear and confusion could be detrimental for the cognitive processes necessary for self-rescue. Also, in 18 °C water the physiological responses represent a potential risk factor for people who suddenly fall into the water. Heart attacks and strokes could represent a relevant risk also in not extremely cold water temperatures, mainly in the elderly or in people with medical history of cardiovascular diseases and hypertension. Without considering some potential pathological issues as a consequence of cool water immersion, survival is possible if people choose the right solutions and the best rescue strategy. Our results show that cognitive performance, in terms of information processing speed, is slightly reduced and behave similarly to the initial responses. Thus, decisions could be negatively affected by this factor and could potentially misevaluate the situation. It is good advice to use the first minutes to calm and decide what to do, being careful and closely evaluating distances and possibilities.

In this study we observed that the SDMT did not alter the physiological responses that were increased because of the cold shock in the first minute after cool water immersion. However, the magnitude of these responses does not seem to be particularly hazardous for the organism. Also, cognitive functions seem to be negatively affected during the first 2 minutes of immersion, indicating a possible effect of the physiological parameters on the psychological response.

CONCLUSIONS

Cold shock after water immersion provokes several physiological responses in non-acclimatized young healthy men. These initial responses were observed also in water temperature of ~18 °C, temperature comparable with many water surfaces in the world. The magnitude and duration of these responses are reduced if compared to results from studies performed in colder water (10 °C and 15 °C). The increased cardiovascular and respiratory strain appearing during the first minutes could impair intensive and complex physical activities. Conversely, planning the rescue strategy can be partially impaired not only by panic but also directly by cold shock. In this study we reported that cognitive functions could be partially reduced after cool water immersion, possibly

because of the physiological responses. Reducing the effects of cold shock through acclimatization, entering slowly into the water or wearing protective clothing, could diminish the risk of cardiorespiratory failure or drowning and it would increase the chances to preserve cognitive performance.

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REPORTS AND REVIEWS/POROČILA IN OCENE, 77–94

THE 61ST ANNUAL MEETING OF AMERICAN COLLEGE OF SPORTS MEDICINE (ACSM)

Orlando, Florida, 27th–31th May 2014

The 61st Annual meeting of American College of Sports Medicine (ACSM) was held at the Orange County Convention Center in Orlando, Florida, from 27th–31st May 2014. Almost 5000 participants from all over the world attended the congress and made it a unique opportunity for attending high-level presentations, meeting researchers from different fields and networking among scientists in the field of sports medicine. The annual congress aimed at delivering knowledge on a number of levels, such as sports medicine from the biomechanical, psychological and biological point of view in both normal and pathological conditions. Numerous clinicians and scientists highlighted the importance of proper physical as well as cognitive activity throughout the lifespan in order to prevent the diseases and conditions that follow physical and cognitive inactivity.

The Annual meeting of the ACSM was attended by two members of the Institute for Kinesiology Research Scientific and Research Centre Koper, University of Primorska, Slovenia. Some of the results from the standard Cross-border Cooperation Programme Slovenia-Italy 2007–2013 PANGeA: Physical Activity and Nutrition for Quality Ageing Project were presented in the section entitled Neuroscience and Ageing Gracefully.

Next year the 62nd Annual meeting of the ACSM will be held from 26th to 30th May in San Diego, California, USA.

Uroš Marušič

REPORTS AND REVIEWS/POROČILA IN OCENE, 77–94

61. LETNO SREČANJE AMERICAN COLLEGE OF SPORTS MEDICINE (ACSM)

Orlando, Florida, 27.–31. maj 2014

61. Letno srečanje American College of Sports Medicine (ACSM) je potekalo med 27.–31. majem 2014 v kongresnem centru Orange County v Orlandu, Florida. Na kongresu je sodelovalo skoraj 5000 ljudi s celega sveta, zaradi česar je kongres predstavljal enkratno priložnost za predstavitve na najvišji ravni, srečanja z raziskovalci z različnih področij in mreženje znanstvenikov s področja medicine športa. Letni kongres je imel za cilj prenos znanja na različnih ravneh, kot so medicina športa z vidika biomehanike, psihologije in biologije tako v normalnih kot tudi patoloških stanjih. Zdravniki in znanstveniki so poudarili pomen primerne telesne in kognitivne aktivnosti tekom celotnega življenja kot tudi preventive za tiste bolezni in stanja, ki izhajajo iz same telesne in kognitivne neaktivnosti.

Letnega srečanja ACSM sva se udeležila dva predstavnika Inštituta za kineziološke raziskave Znanstveno-raziskovalnega središča Univerze na Primorskem. V sekciji z naslovom Nevroznanost in Kakovostno staranje sva predstavila del rezultatov standardnega čezmejnega sodelovanja Slovenija-Italija 2007–2013 PANGeA: Telesna aktivnost in prehrana za kakovostno staranje.

Naslednje leto bo 62. Letni kongres ACSM potekal med 26. in 30. majem v San Diegu, Kalifornija, ZDA.

Uroš Marušič

REPORTS AND REVIEWS/POROČILA IN OCENE, 77–94

CONFERENCE REPORT: 7TH INTERNATIONAL SCIENTIFIC CONFERENCE ON KINESIOLOGY

Opatija, Croatia, 22nd–25th May 2014

During 22nd and 25th May 2014 the 7th International Scientific Conference on Kinesiology was held in Opatija, Croatia, with the working title *"Fundamental and Applied Kinesilogy – Steps Forward"*. It was organized by the Faculty of Kinesiology, University of Zagreb with the patronage of the Croatian Academy of Sciences and Fine Arts and in cooperation with the Science and Research Centre, University of Primorska (Koper, Slovenia), Faculty of Sports Studies Masaryk University (Brno, Czech Republic), Beijing Sport University (Beijing, China) and Lithuanian Sports University (Kaunas, Lithuania). The conference was supported also by several eminent organizations such as European College of Sport Science (ECSS), International Association for Physical Education in Higher Education (AIESEP), International Federation of Physical Education (FIEP) and International Network of Sport and Health Sciences (INSHS), which all contributed to placing the conference within the geographical area and time to a prominent position, as well as rendering it an adequate importance in the field of kinesiology and sport science.

This year 514 scientists and researchers from 32 countries from all over the world presented their work of the past three years in 220 contributions (abstracts and full articles) in eleven oral and poster sections: *"Adapted Physical Activity and Kinesitherapy", "Biology and Medicine of Sport and Exercise", "Kinesiological Recreation", "Kinesiology of Top-Level Sport", "Kinesiology and Social Sciences and Humanities", "Adaptation of Human Organism to Disuse and Ageing", "Physical Education", "Kinesiology in Physical Conditioning", "Management of Sport", "Biomechanics and Motor Control" and "University Sport"*. This time the invited opening lecturers were a prominent strength and conditioning coach and a professor of exercise physiology at the ASPIRE Academy for Sports Excellence in Qatar, Martin Buchheit, Ph.D., Professor, and a renowned professor of clinical physiology at the University of Nottingham and the president of the ECSS, Marco Narici, Ph.D., Professor (Figure 1). Besides the two eminent opening speakers, the plenary sessions greatly completed the conference with many well-known local and foreign names, such as (listing them chronologically, starting with local names first): Herman Berčič, Rado Pišot, Stevo Popović, Vladimir Issurin, Barbara Wessner, Henriette Dancs, Herbert Hartman, Maria Dinold, Annette Hoffman, Steven Fleck, Jaques Duysens, Weimo Zhu, Antonio Méndez Giménez and Branislav Antala.

Figure 1: Martin Buchheit, Ph.D., Professor (left; retrieved from: Linkedin.com) and Marco Narici, Ph.D., Professor (right; retrieved from: kinesiology2014.kif.hr).
Slika 1: Prof. dr. Martin Buchheit (levo; vir: Linkedin.com) in prof. dr. Marco Narici (desno; vir: kinesiology2014.kif.hr)

Figure 2: The winners of the Young Researchers Miloš Mraković's Award, Uroš Marušič (left) in Matej Plevnik, Ph.D. (right; retreived from: Informator Univerze na Primorskem).
Slika 2: Zmagovalca tekmovanja za nagrado Miloša Mrakovića za mlade raziskovalce, Uroš Marušič (levo) in dr. Matej Plevnik (desno).
(desno; vir: Informator Univerze na Primorskem)

Parallel to the conference a Doctoral School washeld, where doctoral students had the opportunity to learn specifically and directly from Martin Buchheit, Herbert Hartman, Vladimir Issurin and Maria Dinold. Even this year, the prestigious Miloš Mraković's Award was granted to encourage research excellence of young researchers up to 33 years. The 1st and 2nd place went to two Slovenian researchers from the University of Primorska, Uroš Marušič and Matej Plevnik, respectively (Figure 2), while the 3rd place went to Dagmar Hrusova, a Czech researcher from the University of Hradec Králové. In his contribution, Uroš Marušič presented the effectiveness of virtual cognitive training on cognitive and physical functioning and efficiency of people who were subjected to a 14-day physical inactivity. Plevnik presented hydrotherapy in the rehabilitation programme for people with muscular dystrophy, while Hrusova showed the effects of a 3-month adapted pilates programme on stabilization and muscle coordination in women with a sedentary job.

The whole conference programme, including a varied and rich social programme, took place in the wonderful 5-star Ambasador hotel, which allowed the participants to network comfortably, to exchange their experiences and ideas with the possibility of further cooperation (Figure 3).

Mitja Gerževič

REPORTS AND REVIEWS/POROČILA IN OCENE, 77–94

POROČILO S 7. MEDNARODNE ZNANSTVENE KONFERENCE O KINEZIOLOGIJI

Opatija, Hrvaška, 22.–25. maj 2014

Od 22. do 25. maja 2014 je v Opatiji na Hrvaškem potekala 7. mednarodna znanstvena konferenca o kineziologiji z delovnim naslovom *"Temeljna in aplikativna kineziologija – nadaljnji koraki"*. Organizirala jo je Fakulteta za kineziologijo Univerze v Zagrebu ob pokroviteljstvu Hrvaške akademije znanosti in umetnosti ter s sodelovanjem Znanstveno-raziskovalnega središča Univerze na Primorskem (Koper, Slovenija), Faculty of Sports Studies Masaryk University (Brno, Republika Češka), Beijing Sport University (Beijing, Kitajska) in Lithuanian Sports University (Kaunas, Litva). Konferenco podpira tudi vrsta uglednih organizacij, kot so European College of Sport Science (ECSS), International Association for Physical Education in Higher Education (AIESEP), International Federation of Physical Education (FIEP) in International Network of Sport and Health Sciences (INSHS), kar ji daje posebno mesto v tem geografskem prostoru in času kot tudi ustrezno pomembnost na področju kineziologije in športne znanosti nasploh.

Letos je 514 znanstvenikov in raziskovalcev iz 32 držav z vsega sveta v 220 prispevkih (izvlečki in polni članki), ustno ali v obliki posterjev, predstavilo svoje delo zadnjih treh let v enajstih vzporednih sekcijah: *"Prilagojena telesna aktivnost in kinezioterapija", "Biologija in medicina športa in vadbe", "Kineziološka rekreacija", "Kineziologija vrhunskega športa", "Kineziologija, družbene vede in humanistika", "Prilagoditve človeškega organizma na neaktivnost in staranje", "Šolska športna vzgoja", "Kineziologija in telesna priprava", "Management športa", "Biomehanika in motorična kontrola"* in *"Univerzitetni šport"*. Otvoritvena predavatelja sta tokrat bila priznani kondicijski trener in profesor fiziologije napora na Akademiji športne odličnosti ASPIRE v Katarju dr. Martin Buchheit ter profesor klinične fiziologije na Univerzi v Nottinghamu in predsednik ECSS dr. Marco Narici (Slika 1). Poleg uglednih otvoritvenih predavateljev pa so na plenarnih predavanjih konferenco kvalitetno dopolnila priznana domača in tuja profesorska imena, kot so (kronološko, kot so se vrstili na programu konference, začenši z domačimi imeni): Herman Berčič, Rado Pišot, Stevo Popović, Vladimir Issurin, Barbara Wessner, Henriette Dancs, Herbert Hartman, Maria Dinold, Annette Hoffman, Steven Fleck, Jaques Duysens, Weimo Zhu, Antonio Méndez Giménez in Branislav Antala.

Slika 3: Družabni program konference v hotelu Ambasador v Opatiji (vir: kinesiology2014.kif.hr)
Figure 3: Conference social programme in the 5-star Ambasador hotel in Opatija. (retreived from: kinesiology2014.kif.hr).

V okviru konference je med drugim potekala tudi šola za doktorske študente, na kateri so se podiplomski študentje lahko posebej učili od Martina Buchheita, Herberta Hartmana, Vladimirja Issurina in Marie Dinold. Mladim raziskovalcem do 33 let so tudi letos podeljevali prestižno nagrado Miloša Mrakovića z namenom spodbujanja raziskovalne odličnosti mladih, kjer sta 1. in 2. mesto zasedla raziskovalca Univerze na Primorskem, Uroš Marušič in Matej Plevnik (Slika 2), medtem ko se je na 3. mesto uvrstila Čehinja Dagmar Hrusova z Univerze Hradec Králové. Prvi je v svojem prispevku predstavil učinkovitost virtualne kognitivne vadbe na kognitivno in gibalno učinkovitost oseb, ki so bile podvržene večdnevni popolni telesni neaktivnosti, drugi prilagojene plavalne aktivnosti za distrofike v rehabilitacijskih programih, tretja pa učinke trimesečnega programa prilagojene vadbe pilatesa na stabilizacijo in mišično koordinacijo pri ženskah, ki opravljajo sedeče poklice.

Celoten program konference, vključno s pestrim in bogatim družabnim programom, se je odvijal v čudovitem hotelu Ambasador s 5 zvezdicami, kar je udeležencem omogočalo sproščeno druženje in povezovanje ter izmenjavo izkušenj in idej za nadaljnje sodelovanje (Slika 3).

Mitja Gerževič

REPORTS AND REVIEWS/POROČILA IN OCENE, 77–94

CONFERENCE REPORT "CHANGING LANDSCAPES IN SPORT: DYNAMICS, HYBRIDITIES AND RESISTANCE" 11TH EUROPEAN ASSOCIATION FOR SOCIOLOGY OF SPORT CONFERENCE (EASS)

Utrecht, Netherlands, 7th–10th May 2014

Academic medieval atmosphere of the central Dom Square (old city centre) University Hall (Academiegebouw), the public face of Utrecht University, was a perfect venue of the 2014 EASS Conference.

This year a record of 170 participants from 23 countries, 138 presentations in 32 thematic sections, was broken, which is a promising sign of an increasing importance of sports exploration and its socio-cultural, socio-political and socio-economic functions that have been taking place currently.

The theme – *"Changing Landscapes in Sport: dynamics, hybridities and resistance"* – of the Conference fits perfectly in the globalising world we live in where changes are apparent anytime and anywhere. To discuss these changes and their consequences for the society at large, as well as to pay attention to the historical, social and cultural contexts of sport is the duty of sport sociologists.

The scientific power of the conference was presented by honourable keynote speakers with the topical thematics: *"Sport policy and the changing landscape of sport in Europe"* by Barrie Houlihan (Loughborough University); *"Sport and the Janus Effect: Gender and the Contradictory Power of Sport"* by Cara Aitchison (University of St Mark and St John); *"Grass roots sports: 50 years of social inequality"* by Koen Breedveld (Mulier Institute & Radboud University) and *"Sports, alienation and the spectacle"* by Mark Gottdiener (University of Buffalo).

Also this year, the thematic symposia presented the following four interesting topics: Gender negotiation and "belonging" in (professional) Sports Biographers: new research perspectives; Measure debate on increasing sports participation and the role of governments; Thematic ball game: challenging landscapes in sports and science and Social perception towards disability sport.

The 32 parallel sessions consisted of some new sessions, namely Legacy of sports events, Sport's fandom, Sport and healthy ageing, Sports promotion and Sport and (new) media which in combination with the ones like Sport and the disabled, Gender perspectives, National identity and similar accomplished the Conference. Multiple perspectives were used to explore the changing landscapes in both the participation and the organisation of sport and physical activity. The Conference stressed the attention to changing social, bodily and life course processes, spatial and geographical perspectives and organizational and policy perspectives in the frame of sports and physical activity.

The EASS congress also granted the 5th EASS Young Researcher Award. This year the first place went to Michelini, a young researcher, for the paper titled *"Disqualification of Sport in Health Related Promotion of Physical Activity – A Global Social Phenomenon"*.

Nevertheless despite the rain and cold weather outside, the social atmosphere and hospitality of the organizers enabled us to share a lot of professional thoughts and ideas for further collaboration and to bring back home pleasant memories of Utrecht's cyclers and footballers' fandom.

The following opportunity to exchange new perspectives from the field of Sports Sociology will take place on the 12th EASS Conference in Dublin (Ireland), from June 10th to June 13th 2015 carrying the title: "Sport, Unity, & Conflict".

Saša Pišot

REPORTS AND REVIEWS/POROČILA IN OCENE, 77–94

POROČILO Z 11. KONFERENCE EVROPSKEGA ZDRUŽENJA ZA SOCIOLOGIJO ŠPORTA (EASS) "SPREMINJANJE PODOBE ŠPORTA: DINAMIKA, HIBRIDNOST IN ZOPERSTAVLJANJE"

Utrecht, Nizozemska, 7.–10. maj 2014

Akademsko vzdušje srednjeveške univerzitetne dvorane (Academiegebouw) v starem mestnem jedru Utrechta je bilo več kot prijetno mesto letošnje EASS konference 2014. Rekordno število 170 udeležencev iz 23 držav, 138 predstavitev na 32 tematskih sklopih je zagotovo obetaven dokaz vse večje pomembnosti raziskovanja športa in njegovih socio-kulturnih, družbeno-političnih in gospodarskih funkcij.

Glavna tema *"spreminjanje podobe športa: dinamika, hibridnost in zoperstavljanje"* se odlično prilega neobhodnim spremembam globaliziranega sveta, v katerem živimo. Da se o teh spremembah in njihovih posledicah za celotno družbo razpravlja v luči zgodovinskih, družbenih in kulturnih kontekstov športa, je dolžnost vseh športnih sociologov.

Znanstveni doprinos konference beležimo v aktualnih predstavitvah eminentnih plenarnih predavateljev na teme: "*Politike v športu in spreminjajoče se okolje športa v Evropi",* Barrie Houlihan (Loughborough University); "*Šport in Janusov efekt: spol in kontradiktorna moč športa",* Cara Aitchison (University of St Mark in St John); "*Samonikli športi: 50 let socialne neenakosti"*, Koen Breedveld (Mulier Institute & Radboud University) in "*Šport, odtujenost in spektakel"*, Mark Gottdiener (Univerza v Buffalu).

Tudi letos so bile na tematskih simpozijih predstavljene tri aktualne teme: spol, pogajanja in pripadnost v profesionalnem življenju športnika: nove raziskovalne možnosti; razprava o merjenju in zajemanju udejstvovanja v športu in vloga državnih institucij; igre z žogo: izziv prostora v športu, znanosti in socialni percepciji športa invalidov.

Legalnost športnih dogodkov, Športno navijaštvo, Šport in zdravo staranje, Promocija športa in šport (v novih medijih) so bile nove tematske sekcije, ki so poleg zanimivih sekcij – Šport in invalidne osebe, Enakosti spolov, Nacionalna identiteta in drugih – potekale na 32 vzporednih sekcijah. Več perspektiv je bilo namenjenih raziskovanju spreminjajoče se podobe sodelovanja in organizacije športa in telesne dejavnosti. Posebna pozornost je bila namenjena diskusiji o spreminjanju družbenih procesov, fizičnih procesov in procesa življenjskih potekov, novim prostorskim in geografskim perspektivam ter organizacijskim in političnim vidikom gibalne/športne aktivnosti.

Čast 5. zmagovalca nagrade mladih raziskovalcev je letos pripadla g. Micheliniju za prispevek z naslovom *"Diskvalifikacija športa v povezavi s spodbujanjem telesne dejavnosti za zdravje – globalni družbeni pojav"*.

Kljub dežju in hladnem vremenu sta simpatično vzdušje in gostoljubnost organizatorjev omogočila prijetno druženje in izmenjavo idej za nadaljnje sodelovanje ter pustila Utrecht in njegove kolesarje ter nogomet v prijetnem spominu.

Naslednja priložnost za izmenjavo novih perspektiv sociologije športa bo na 12. konferenci EASS, ki bo tokrat v Dublinu (Irska) od 10.–13. junija 2015 z naslovom: "Šport, enotnost in konflikt".

Saša Pišot

REPORTS AND REVIEWS/POROČILA IN OCENE, 77–94

19TH ANNUAL CONGRESS OF THE EUROPEAN COLLEGE OF SPORT SCIENCE

"SPORT SCIENCE AROUND THE CANALS"

Amsterdam, Netherlands, 2nd –5th July 2014

The 19th annual Congress of the European College of Sport Science, ECSS Amsterdam 2014, entitled *"Sport Science around the Canals"*, was held between 2nd and 5th July 2014 in Amsterdam, The Netherlands. It was the second largest congress in the history of the ECSS, this year hosted by VU University Amsterdam (Dutch: Vrije Universiteit Amsterdam).

Some congress fact: the congress was attended by 2760 participants, coming from 75 countries worldwide, who submitted 1908 abstracts. The congress consisted of 8 keynote lectures, 114 invited presentations, 896 oral presentations, 410 mini-oral and 488 e-poster presentations. The participants presented their latest research findings in the fields of kinesiology, sport, nutrition, physical activity, physiology, neuroscience, sport training, sport pedagogy and sport management, among others. The scientific and the professional part of the congress was divided in three main subdivisions: a Scientific Part (research presentations, plenary sessions, memorial lectures and symposiums), a Satellite Symposia and Technical Sessions. Some of the sessions were available on ECSS.zv and/or ECSS Youtube Channels, a free of charge service for all ECSS members. Contributions were published in peer-review symposium proceeding book of abstracts.

The RAI Convention Centre was a great venue for the 19th ECSS Congress, as it provided functional facilities for all the activities during the congress, from exhibition and various scientific sessions to social events and networking.

(retreived from: sport-science.org)

It was my great pleasure and honour that I spent a few days in Amsterdam with my colleagues from the Institute for Kinesiology Research at SRC UP and others, getting acquainted with some very interesting topics as well as spending time sightseeing while immersed in interesting conversations with other participants.

The next ECSS congress will be held between 24th and 27th June 2015 in Malmö, Sweden.

Matej Plevnik

REPORTS AND REVIEWS/POROČILA IN OCENE, 77–94

19. LETNI ZNANSTVENI KONGRES EUROPEAN COLLEGE OF SPORT SCIENCE

"SPORT SCIENCE AROUND THE CANALS"

Amsterdam Nizozemska, 2.–5. julij 2014

19. letni kongres European Sollege of Sport Science, ECSS Amsterdam 2014, z naslovom *"Sport Science around the Canals" [Športna znanost med kanali]* je v letošnjem letu potekal med 2. in 5. julijem 2014 v Amsterdamu na Nizozemskem. Letošnji kongres je bil po številu udeležencev drugi največji kongres ECSS in ga je v letošnjem letu gostila VU Univerza Amsterdam (nizozemsko: Vrije Universiteit Amsterdam).

Nekaj dejstev o kongresu: kongresa se je udeležilo 2760 udeležencev iz 75 držav sveta, ki je prijavilo 1908 prispevkov. Na kongresu je bilo predstavljenih osem uvodnih predavanj, 114 vabljenih predstavitev, 896 ustnih predstavitev prispevkov, 410 kratkih ustnih predstavitev in 488 e-poster predstavitev. Udeleženci so predstavljali raziskovalne rezultate interdisciplinarnih področij kineziologije, športa, nutricionistike, telesne aktivnosti, fiziologije, nevroznanosti, športnega treninga in vadbe, pedagogike športa, menedžmenta športa in drugih. Znanstveni in strokovni del kongresa je bil razdeljen na tri glavne dele, na Znanstveni del (predstavitve prispevkov in raziskovalnih ugotovitev, uvodna predavanja, spominska predavanja in simpoziji), na Satelitski simpozij in Tehnične predstavitve. Zanimivejše predstavitve so članom ECSS brezplačno dostopne tudi na ECSS.tv in/ali Youtube portalu ECSS. Prispevki kongresa so bili objavljeni v recenziranem zborniku izvlečkov.

Prizorišče 19. letnega kongresa ECSS je bil kongresni center RAI, ki je nudil vse potrebne kapacitete za vse aktivnosti kongresa, od razstav opreme do različnih znanstvenih sestankov in socialnih dogodkov ter mreženja.

(vir: sport-science.org)

V veliko čast si štejem, da sem dneve v Amsterdamu preživel v družbi sodelavcev Inštituta za kineziološke raziskave UP ZRS in drugih. Predstavitve znanstvenih prispevkov, ogledovanje mestnih znamenitosti ter prijetni strokovni in družabni pogovori so letošnji kongres ECSS prijetno obogatili.

Naslednji kongres ECSS bo potekal od 24. do 27. junija 2015 v Malmu na Švedskem.

Matej Plevnik

REPORTS AND REVIEWS/POROČILA IN OCENE, 77–94

BOOK REVIEW
EDVARD KOLAR, GREGOR JURAK: STRATEŠKI MANAGEMENT ŠPORTNIH ORGANIZACIJ

University of Primorska, Science and Research Centre,
Annales University Press, 2014, 223 pages

The monograph *"Strategic management of sports organizations"* by the authors Edvard Kolar and Gregor Jurak, prominent researchers, pedagogues and managers in sport, tackles the increasingly complex and demanding management in sport. Despite the topical subject there is still not enough literature of this kind in Slovenian language, hence, their work is even more important and represents a contribution to the understanding of the organisation and functioning of sport, especially Slovenian. In the first part, the authors present the concept of sports organization, organizational structure and organizational processes; considerable attention is paid to the non-profit sports organizations that are specific to our sport environment. In the second part the process of strategic management of sports organizations is transparently explained and an in-depth project work as a key tool for the implementation of strategies presented.

As the authors draw knowledge from a number of high-quality domestic and foreign sources and from their rich personal experience, the text is despite scientific approach very readable. The monograph has in addition to scientific also educational and practical value, especially due to its originality, transparency and best practices on how to successfully deal with sports organizations, especially from the point of view of strategic management. For the successful development of sports organizations and thus sport as a whole a well-conceived strategy is crucial; it represents the starting point for the efficient and effective implementation of each sport organization's mission, both, the profit and non-profit one.

Congratulations to my colleagues Edvard Kolar and Gregor Jurak for a great book that should not be missing on the shelves of professional and voluntary experts who deal with management in sport.

Iztok Retar

REPORTS AND REVIEWS/POROČILA IN OCENE, 77–94

RECENZIJA KNJIGE EDVARD KOLAR, GREGOR JURAK: STRATEŠKI MANAGEMENT ŠPORTNIH ORGANIZACIJ

Univerza na Primorskem, Znanstveno-raziskovalno središče, Univerzitetna založba Annales, 2014, 223 strani

Monografija "*Strateški management športnih organizacij"* avtorjev Edvarda Kolarja in Gregorja Juraka, uveljavljenih raziskovalcev, pedagogov in menedžerjev v športu, obravnava problematiko vse bolj zahtevnega menedžmenta v športu. Kljub aktualni temi je v slovenskem jeziku še vedno premalo tovrstne literature, zato je njuno delo še toliko bolj pomembno in predstavlja prispevek k razumevanju organiziranosti in delovanja športa, še posebej slovenskega.

V prvem delu avtorja predstavita pojem športne organizacije, organizacijsko strukturo in organizacijske procese, precej pozornosti namenita tudi nepridobitnim športnim organizacijam, ki so značilne za naše športno okolje. V drugem delu pregledno razložita proces strateškega managementa športnih organizacij in poglobljeno predstavita projektno delo kot ključno orodje za udejanjanje strategij.

Ker avtorja črpata znanje iz številnih kakovostnih domačih in tujih virov ter iz bogatih osebnih delovnih izkušenj, je besedilo navkljub znanstvenemu pristopu zelo berljivo. Monografija ima poleg znanstvene še izobraževalno in uporabno vrednost, zlasti zaradi izvirnosti, preglednosti in praktičnih zgledov, kako uspešno ravnati s športnimi organizacijami, še posebej z vidika strateškega menedžmenta. Za uspešen razvoj športne organizacije in s tem tudi športa je namreč ključnega pomena dobro zasnovana strategija, ki predstavlja izhodišče za učinkovito in gospodarno uresničevanje poslanstva športne organizacije, tako pridobitne kot nepridobitne.

Čestitke kolegoma Edvardu Kolarju in Gregorju Juraku za izvrstno knjigo, ki ne sme manjkati na policah poklicnih in volonterskih strokovnjakov, ki se ukvarjajo z menedžmentom v športu.

Iztok Retar

GUIDELINES FOR AUTHORS, 95–99

GUIDELINES FOR AUTHORS

1. **Aim and scope of the journal:**
   Annales Kinesiologiae is an international interdisciplinary journal covering kinesiology and its related areas. It combines fields and topics directed towards the study and research of human movement, physical activity, exercise and sport in the context of human life style and influences of specific environments. The journal publishes original scientific articles, review articles, technical notes and reports.

2. **General policy of Annales Kinesiologiae**
   Annales Kinesiologiae pursues the multi-disciplinary aims and nature of Kinesiology with the main goal to promote high standards of scientific research.

   a) Reviewing: Each manuscript, meeting the technical standards and falling within the aims and scope of the journal, will be subjected to a double-blind peer-review by two reviewers. Authors can propose up to two reviewers for revision of their work and also up to two reviewers they would like to avoid.

   The referees are chosen by the Editors. Assessments by the referees will be presented anonymously to the author and will be returned to the author for correction. The corrected copy of the manuscript, with the list of corrections on a separate page, should be returned to the responsible Editor.

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d) Copyright agreement: After the editorial acceptance of the manuscript, the first author will be asked to fill in the copyright agreement for which a paper copy needs to be received at the secretary of Annales Kinesiologiae.

3. Manuscript preparation

a) Language and Style: The language of Annales Kinesiologiae is USA English. The authors are responsible for the language, grammar, and style of the manuscript, which need to meet the criteria defined in the guidelines for authors. Manuscripts are required to follow a scientific style style. The journal will be printed in gray-scale.

b) The length of the manuscript should not exceed 36,000 characters (excluding spaces).

Text formatting: It is required to use the automatic page numbering function to number the pages. Times New Roman font size 12 is recommended, with double spacing between lines. Use the table function, not spreadsheets, to make tables. Use an equation editor for equations. Finally, all lines need to be number, were the first sentence of a pages is assigned line number 1.

c) Miscellaneous: Whenever possible, use the SI units (Système international d'unités).

d) The title page should include the title of the article (no more than 85 characters, including spaces), full name of the author(s) and affiliations (institution name and address) of each author; linked to each author using superscript numbers, as well as the corresponding author's full name, telephone, and e-mail address.

e) The authors are obliged to prepare two **abstracts** – one short abstract in English and one (translated) in Slovene language. For foreign authors translation of the abstract into Slovene will be provided. The content of the abstract should be structured into the following sections: purpose, methods, results, and conclusions. It should only contain the information that appears in the main text, and should not contain reference to figures, tables and citations published in the main text, and should not exceed 250 words.

f) Under the abstract a maximum of 6 appropriate **Keywords** shall be given in English and in Slovene. For foreign authors the translation of the abstract into Slovene will be provided.

g) The **main text** should include the following chapters: Introduction, Methods, Results, Discussion, Conclusions, Acknowledgement (optional), and References. Individual parts of the text can form sub-sections.

h) Each **Table** should be submitted on a separate page in a Word document after the Reference section. Tables should be double-spaced. Each table shall have a brief caption; explanatory matter should be in the footnotes below the table. Abbreviations used in the tables must be consistent with those used in the main text and figures. Definitions of symbols should be listed in the order of appearance, determined by reading horizontally across the table and should be identified by standard symbols. All tables should be numbered consecutively Table 1, etc. The preferred location of the table in the main text should be indicated preferably in a style as follows: *** Table 1 somewhere here ***.

i) Captions are required for all **Figures** and shall appear on a separate manuscript page, under the table captions. Each figure should be saved as a separate file without captions and named as Figure 1, etc. Files should be submitted in *.tif or *.jpg format. The minimum figure dimensions should be 17 x2 0 cm and a resolution of at least 300 dpi. Combinations of photo and line art should be saved at 600–900 dpi. Text (symbols, letters, and numbers) should be between 8 and 12 points, with consistent spacing and alignment. Font type may be Serif (Times Roman) or Sans Serif (Arial). Any extra white or black space surrounding the image should be cropped. Ensure that participant-identifying information (i.e., faces, names, or any other identifying features) should be omitted. All figures should be numbered consecutively Figure 1, etc. The preferred location of the figure in the main text should be indicated preferably in a style as follows: *** Table 1 somewhere here ***.

j) References

The journal uses the Harvard reference system (Publication Manual of the American Psychological Association, 5th ed., 2001), see also: http://www.apastyle.org). The list of references should only include work cited in the main text and being published or accepted for publication. Personal communications and unpublished works should only be mentioned in the text. References should be complete and contain up to six authors. If the author is unknown, start with the title of the work. If you are citing work that is in print but has not yet been published, state all the data and instead of the publication year write „in print“.

Reference list entries should be alphabetized by the last name of the first author of each work. Titles of references written in languages other than English should be additionally translated into English and enclosed within square brackets. Full titles of journals are required (no abbreviations).

Examples of reference citation in the text

One author: This research spans many disciplines (Enoka, 1994) or Enoka (1994) had concluded ...

Two authors: This result was later contradicted (Greene & Roberts, 2005) or Greene and Roberts (2005) pointed out ...

Three to five authors:
a) first citation: Šimunič, Pišot, and Rittweger (2009) had found ... or (Šimunič, Pišot, & Rittweger, 2009)
b) second citation: Šimunič et al. (2009) or (Šimunič et al., 2009)

Six or more authors:
Only the first author is cited: Di Prampero et al. (2008) or (Di Prampero et al., 2008).

Several authors for the same statement with separation by using a semicolon: (Biolo et al., 2008; Plazar & Pišot, 2009)

Examples of reference list:
The style of referencing should follow the examples below:

Books:
Latash, M. L. (2008). Neurophysiologic basis of movement. Campaign (USA): Human Kinetic.

Journal articles
Šarabon, N., Kern, H., Loefler, S., & Rošker. J. (2010). Selection of body sway parameters according to their sensitivity and repeatability. Basic and Applied Myology, 20(1), 5–12.
De Boer, M. D., Seynnes, O., Di Prampero, P., Pišot, R., Mekjavić, I., Biolo, G., & Narici, M. V. (2008). Effect of 5 weeks horizontal bed rest on human muscle thickness and architecture of weight bearing and non-weight bearing muscles. European journal of applied physiology, 104(2), 401–407.

Book chapters
Šimunič, B., Pišot, R., Mekjavić, I. B., Kounalakis, S. N., & Eiken, O. (2008). Orthostatic intolerance after microgravity exposures. In R. Pišot, I. B. Mekjavić, & B. Šimunič (Eds.), The effects of simulated weightlessness on the human organism (pp 71–78). Koper: University of Primorska, Scientific and research centre of Koper, Publishing house Annales.
Rossi, T., & Cassidy, T. (in press). Teachers' knowledge and knowledgeable teachers in physical education. In C. Hardy, & M. Mawer (Eds.), Learning and teaching in physical education. London (UK): Falmer Press.

Conference proceeding contributions

Volmut, T., Dolenc, P., Šetina, T., Pišot, R., & Šimunič, B. (2008). Objectively measures physical activity in girls and boys before and after long summer vacations. In V. Štemberger, R. Pišot, & K. Rupret (Eds.) Proceedings of 5th International Symposium A Child in Motion "The physical education related to the qualitative education" (pp 496–501). Koper: University of Primorska, Faculty of Education Koper, Science and research centre of Koper; Ljubljana: University of Ljubljana, Faculty of Education.

Škof, B., Cecić Erpić, S., Zabukovec, V., & Boben, D. (2002). Pupils' attitudes toward endurance sports activities. In D. Prot, & F. Prot (Eds.), Kinesiology – new perspectives, 3rd International scientific conference (pp 137–140), Opatija: University of Zagreb, Faculty of Kinesiology.

4. Manuscript submission

The main manuscript document should be saved as a Word document and named with the first author's full name and the keyword manuscript, e.g. *"Pisot_Rado_manuscript.doc"*. Figures should be named as "*Pisot_Rado_Figure1", etc.*

The article should be submitted via e-mail: **annales.kinesiologiae@zrs.upr.si.**

Reviewing process communication will proceed via e-mail.

5. For additional information regarding article publication, please do not hesitate to contact the secretary of Annales Kinesiologiae.


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