2. Mednarodni znanstveni simpozij |
2. International scientific symposium

Zdrav življenjski slog med mitom in resničnostjo|

Healthy Life Style Between Myth and Reality

Zbornik prispevkov z recenzijo |
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Prizorišče | Venue
Domus Medica, Ljubljana

Datum |Dates
15. in 16. Maj 2014 |15 and 16 May 2014

Soorganizatorji | Co-organizers
Medical Chamber of Slovenia (ZZS) with partners and coworkers (University Medical Center Ljubljana, (UKC LJ), University Medical Center Maribor (UKC MB), Family Medicine Dpt of Medical Faculty, University Ljubljana, RC IKTS Žalec)

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Strojnik	**PHYSICAL EXERCISE FOR SUCCESSFUL AGING**
Vute	**THE WHY AND WHAT OF SPORT ACTIVITIES FOR SENIORS**
Rugelj, Novak	**BALANCE SPECIFIC EXERCISE PROGRAMS FOR THE ELDERLY**
Klemenc, Princi, Accardo, Golja	**ARE EFFECTS OF CARBOHYDRATE INGESTION AND HYPOXIA GENDER-RELATED**
Ihan	**ASSESING BIOMARKERS IN BIOLOGICAL FLUIDS OF HEALTHCARE WORKERS**
Tusak, Kovač	**MIND AND LIFESTYLE**
Hanin	**OPTIMAL FEELING STATES AND PERFORMANCE**

Healthy Life Style Between Myth and Reality – International Symposium

Domus Medica, Ljubljana, Slovenia, 15. – 16. 5. 2014

Programme:
(Symposium is held in English)

Thursday, May, 15th 2014:

14.30 - 15.00	Registration
15.00 - 15.30	Welcome speeches: - Andrej Možina, Medical Chamber of Slovenia - Vesna Kerstin Petrič, Ministry of Health - Samo Fakin, Health Insurance Institute of Slovenia - Prof. Bruce D. Johnson, Mayo Clinic - Janez Uplaznik, Organizing Committee
15.30 – 17.30	1. Session: **Healthy Aging** **V. Strojnik, F. Schena, Chairs** Vojko Strojnik: Physical exercise for successful aging Federico Schena: Influence of Physical activity on Cognitive abilities in old ages Rajko Vute: The Why and What of sport activities for seniors Darja Rugelj: Falls and Balance in old ages
17.30 – 18.00	Break
18.00 – 20.00	2. Session: **Tracking the parameters of Life Style** **Z. Fras, A. Issa, Chairs** Zlatko Fras: Self-rated health and cardiovascular risk factors: is there a connection? Matjaž Klemenc: Gender-related effects of carbohydrate ingestion and hypoxia on heart rate variability : linear and non-linear analysis Amine Issa: Creating the right health and lifestyle application Juraj Sprung: Surgical anesthesia and Alzheimer's disease

Friday, May 16th 2014:

08.00 - 08.30	Registration
08.30 - 10.30	3. Session: **Strengthening Health for Health Professionals** **A. Ihan, J. Sprung, Chairs** Metoda Dodič Fikfak: The health status of Physicians in Slovenia John Eisenach: The Psychological and Physiological Effects of Acute Occupational Stress in New Resident Physicians: Implications for Corporate Wellness Programs Alojz Ihan: Assessing biomarkers in biological fluids of GP doctors reporting high workload - preliminary results Alexandros Giannakis: SenseCore - Human Performance and Well-Being Solutions
10.30 – 11.00	Break
11.00 – 13.00	4. Session: **Metabolic Syndrome and Diabetes** **A. Janež, B. Johnson, Chairs** Andrej Janež: Metabolic improvement and reduction of severe hypoglycemia after an out-patient education program for functional insulin therapy in adult type 1 diabetic patients Bruce Johnson: Can long-term excessive endurance exercise induce adverse cardiovascular outcomes John Miles May: Treating Type 2 diabetes with cardiovascular outcomes in mind Nada Rotovnik Kozjek: Nutrition and physical exercise, the role in healthy lifestyle
13.00 – 15.00	5. Session: **Psychology of Life Style** **M Tušak, M. M. Clark - Chairs** Matej Tušak: Mind and Life Style Mathew M. Clark: Resiliency for the Employee: The Mayo Clinic Approach Jurij Hanin: Optimal Feeling States and Performance: An Individualized Approach Paul Jimenez: The successful integration of Web- and App-based Interventions into Occupational Health Projects. Influences on physical and psychological life style and job motivation
15.00 – 16.00	Lunch Break

Scientific Committee: Prof. Alojz Ihan, M.D., Ph.D., Asist. Prof. Zlatko Fras, M.D., Ph.D., Prof. Vojko Strojnik, B. Sc., Prof. Matej Tušak, B. Sc., Ph.D., Prof.Marjan Heričko, B. Sc., Ph. D., Janez Uplaznik, Prof. Juraj Sprung, M.D., Ph.D., Prof. Bruce Johnson, M.D., Ph.D.

CME/CPD Credit Points: 10,5

Registration: http://domusmedica.si/dogodki/ali na: mic@zzs-mcs.si

Registration Fee: Participation is free.

Lecturers: M.M. Clark (Mayo, ZDA), M. Dodič Fikfak (UKC Ljubljana, Slovenia), J. Eisenach (Mayo, ZDA), Z. Fras (UKC Ljubljana, Slovenia), A. Giannakis (Sensecore, Switzerland), J. Hanin (Research Institute for Olympic sports, Jyväskylä, Finland), A. Ihan (Medical Faculty UL, Slovenia), A. Issa (Mayo, ZDA), A. Janež (UKC Ljubljana, Slovenia), P. Jimenez (University Graz, Austria), B. Johnson (Mayo, ZDA), M. Klemenc (SB Nova Gorica, Slovenia), J. Miles May (Mayo, ZDA), N. Rotovnik Kozjek (Onkology Institute, Slovenia), D. Rugelj (Faculty of Health Science UL, Slovenia), F. Schena (University Verona, Italy), J. Sprung (Mayo, ZDA), V. Strojnik (Faculty of Sport UL, Slovenia), M. Tušak (Faculty of Sport UL, Slovenia), R. Vute (Faculty of Education UL, Slovenia).

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Organizers: Medical Chamber of Slovenia (ZZS) with partners and coworkers (University Medical Center Ljubljana, (UKC LJ), University Medical Center Maribor (UKC MB), Family Medicine Dpt of Medical Faculty, University Ljubljana, RC – IKTS Žalec.

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PHYSICAL EXERCISE FOR SUCCESSFUL AGING

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Keywords: elderly, sarcopenia, resistance training, aerobic capacity, aerobic training

Abstract. Regular physical activity, especially in a form of exercise training has potential to maintain mobility and independence in older age. It reduces negative trends due to aging or even reverses them. Sarcopenia is progressive generalized loss of skeletal muscle mass, strength, and function (daily activities, falls, etc.) due to aging. There are several alternatives tackling a problem of reducing muscle mass. Pharmacological interventions have shown limited efficacy in counteracting the effects of sarcopenia and may have negative side effects as well. Proper nutrition and resistance training remain the most effective and safe interventions for preventing sarcopenia. With proper resistance training older person can expect not only to prevent sarcopenia and decreased strength, but also improve strength and power. Application of resistance training in elder persons has the same characteristics as in younger adults. Aerobic capacity decline with aging as well. It should be maintained over ~18 ml/kg/min to provide a functional reserve. Aerobic training can be equally effective in younger and old adults. It is recommendable in many impaired health conditions including cardiovascular disease, hypertension, obstructive pulmonary disease, type 2 diabetes mellitus, osteoporosis, etc. Important factor to promote physical activity in older population are physicians with their recommendations.

Introduction

There are many good reasons why older persons should not only be physical active but do physical exercise regularly. The final goal is maintaining mobility and independence until the individual limit of chronological age. Mobility and independence are related to biological, psychological, and social aspects of living. As living age is increasing, these questions become vital not only for individuals but for a society as well. Frailty is a common and important geriatric syndrome characterized by age-associated declines in physiologic reserve and function across multiorgan systems, leading to increased vulnerability for adverse health outcomes [1]. It is directly and indirectly related to function of physiologic systems, such as the musculoskeletal, endocrine, and hematologic systems.

The aim of this paper is present changes in the body systems, especially those related to reduced mobility as decline in maximal aerobic capacity [2] and senile sarcopenia [3]. Of course, there are many other changes related to aging (e.g. cognitive function) which need to be addressed as well. However, mobility seems to be very basic condition and have strong impact to all others.

Sarcopenia

Senile sarcopenia, the loss of muscle mass associated with aging, is a main cause of muscle weakness in old age. It starts after the age of 50, and by the 8th decade muscle mass attains approximately 60% of that at the 2nd decade [4]. The etiology of sarcopenia is complex and involves multiple factors (Fig. 1). Its main reason is a Moto neuron death which results in reduced number of motor units and muscle fibers. Muscle fibers may also die independently of the Moto neuron death [5].

Muscle fiber size decreases (atrophy) with aging as well due to decrease in growth factors [6] and reduces physical activity. The later may contribute to muscle cell apoptosis. Other factors as nutritional, hormonal and immunological factors have been shown to contribute to sarcopenia. Reduced food intake and low vitamin D increase potential for muscle mass reduction [3]. Finally, atrophy may result from smaller anabolic activity due to reduced level of anabolic hormones of increased catabolic activity [7].

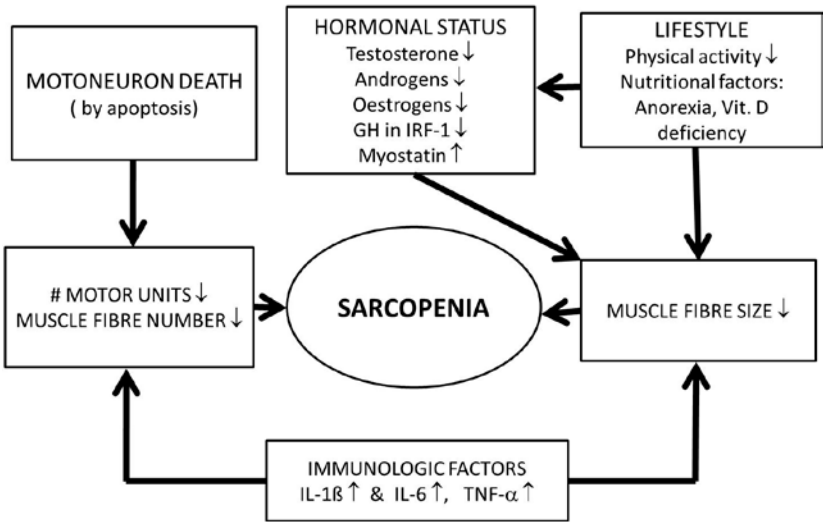

Fig. 1 Aetiology of sarcopenia (adapted from [3])

Neuromuscular function in old age

Muscle strength in old age decreased more than muscle size [8]. It is related to smaller number of actomyosin cross-bridges [9] and reduced excitation-contraction coupling [10]. Important factor are changes in muscle activation [11] with reduced neural drive to agonists and increased to antagonists. Increased muscle coactivation may reduce joint netto torque but increase its stiffness.

Changes in muscle architecture due to older age may also contribute to lower muscle force [12]. Muscle fascicle length and pennation angles in older individuals are smaller than in younger adults. This points to reduced number of sarcomeres in series as well as in parallel in older age. It is known that prolonged muscle stretching increases number of sarcomeres in series and that resting in shortened position reduce their number. Additionally, smaller load in older age may reduce the number of sarcomeres in series. Changes in muscle architecture will change force-length and force-velocity relationships [13].

Neuromuscular changes in older age will result in reduced shortening velocity and rate of force development. The main reason is selective Moto neuron death which is more pronounced in thick neurons innervating fast motor units. Therefore muscle cells death will be more pronounced in fast muscle cells. This will have most strongly impact on explosive actions as needed for balance or other fast reactions. Some of the muscle cells of denervated motor units will be reinervated with other Moto neurons. Consequently, the number of motor units in the muscle will reduce and the innervation ratio increase. This may worsen motor control due to less precise muscle force control.

Changes at cortical and subcortical level in older age

Strength reduction can also be due to changes at cortical level. Studies showed significant cortex regional atrophy in older subjects that would affect cortico-cortical and corticospinal connectivity [14, 15]. Aging is also related to cortical hypoexcitability, increased activation in areas of sensory processing and integration during motor tasks, and reduced cortical plasticity [16], e.g., older adults are less able to increase activity when increased handgrip force is required [17].

Central drive to the muscles is reduced with age contributing to lower muscle forces. However, there are significant differences among the muscles. This can be readily observed in elbow flexors and knee extensors, but not in dorsiflexors or hamstrings [16]. As similar peak levels of voluntary activation may be observed in old and young adults (96% and 98%, respectively), older exhibit much greater variability among attempts. Peak voluntary elbow flexors activation in older subjects was 96%, while mean of 10 attempts was 79% [18].

Training in older age can change neuromuscular function

Strength training has been shown to improve or at least slow down negative changes in neuromuscular function due to aging. After three months of strength training expected changes in muscle size would be in a range of 5-17% [3] which is comparable to increases in young adults for similar periods of training. Muscle fascicle length and pennation angle increases with strength training. This will result in greater strength, higher shortening velocity and more optimal force-length relationship [19, 20] (Fig. 2).

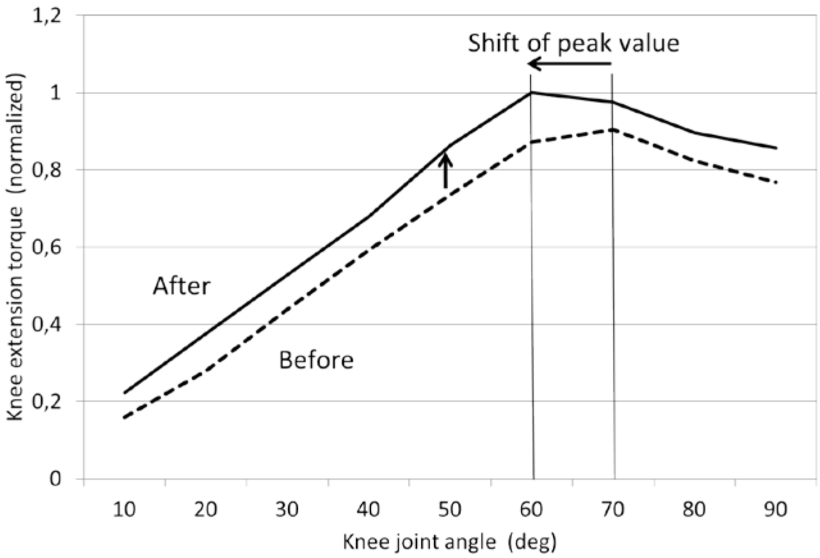

Fig. 2 Change of torque-joint angle relationship after strength training (adapted from [3])

Another mechanism, next to hypertrophy, responsible for strength gains due to training is muscle activation. Strength gain in training apparatus expressed as repetition maximum is usually much greater than isometric strength. This means that the activation adaptation includes other mechanisms as intermuscular coordination than increased central drive to the agonist.

Strength training can be performed at different intensity levels, from 40% to 90% of 1RM. High intensity (≥ 80% 1RM or more) was associated with greater strength improvements among older population than performed with moderate (60% to 80% of 1RM) or low (< 60% of 1RM) intensity [21]. Intensity 80% of 1RM or more is related to hypertrophy and muscle activation training which both increase maximum strength and prevent neuromuscular changes due to aging. There is still debate should strength training for older persons be structured similarly as in younger adults and it seems that the answer is yes.

Significant strength adaptation is possible also in the “oldest old” [22]. It may be expected that the benefits of strength acquisition will translate to preservation of functional movement capacity and instrumental activities of daily living, prevention of disability, and maintenance of independence and autonomy [21, 23]. There are no significant differences in potential adaptive-response between men and women in old age.

Finally, various nutritional supplements may be employed to treat sarcopenia including protein intake, hormone therapy, ACE inhibitors, creatine, etc. Although they may be effective, they often have negative side effects [24].

Aerobic capacity in old age

Aerobic capacity is a measure of cardiovascular fitness. Since cardiovascular disease is one of major health problems in older population it is important to increase this functional capacity and maintain it at high level. Peak VO_2 declines 8-10% per age decade in healthy men and women. This increases up to 20-25% after age of 70 years [25]. The same trend is observed also in highly active individuals; however, their aerobic capacity is much higher (30-40% at age of 60-80 years) of their age peers [26]. It is estimated that peak VO_2 of ~18 ml/kg/min would distinguishing between low and high physical activity at age of 65-90 years [27]. In patients with chronic heart failure peak VO_2 is lower than above limit already at younger age.

Training of aerobic capacity in old age

Aerobic capacity can be increased also in old age. Gains are similar as in younger adults and account up to 25%. Training with higher intensity and longer duration will elicit greater improvement [28]. But are increases in peak VO_2 due to training possible also in older people with cardiac disease? Again as in healthy older adults, traditional cardiac rehabilitation will increase functional capacity to similar extent as in their younger counterparts [29]. Mean increase of 16% in peak VO2 among 60 patients aged 65±5 years following 3 months of training beginning 8 weeks after myocardial infarction (MI) or coronary revascularization was observed.

Other benefits of aerobic training in old age

Systolic blood pressure elevation is a potent risk factor for stroke, heart failure, coronary events, and chronic kidney disease, all common disorders on the elderly. Regular aerobic exercise reduces blood pressure at all ages. Mean systolic and diastolic blood pressure may be reduced for -3.84 mm Hg and -2.58 mm Hg, respectively [30]. A reduction in blood pressure was associated with aerobic exercise in hypertensive participants and normotensive participants and in overweight participants and normal-weight participants.

Aerobic exercise training has beneficial effects on blood lipids levels, which are important risk factor for cardiovascular disease in older age. Studies show that aerobic training promotes high density lipoprotein (HDL) content to increase and low density lipoprotein to decrease. Consequently, total cholesterol/HDL ratio decreases. Average HDL increase due to aerobic training averaged 2.5 mg/dl [31].

Reduced insulin sensitivity, which impairs glucose tolerance and may result in type 2 diabetes mellitus, is another problem occurring with advanced age. General decrease in physical activity with age may additionally contribute to its occurrence. Aerobic exercise training may efficiently prevent or reduce glucose intolerance. Additional diet will make treatment more effective. Exercise in older persons with type 2 diabetes mellitus, especially if they are not customized to exercise, may elevate a risk of exercise. A range of mild to severe acute risks were identified with exercise (musculoskeletal injury, hypoglycemia, foot ulceration, proliferative retinopathy, hypotension) but the overall prevalence was low [32]. It appears that increased PA is a relatively safe procedure with no evidence of a loss of life.

Bone density reduction is present in both sexes in older age. The problem is more pronounced in post-menopausal women; however its occurrence in men is increasing. Aerobic exercise with impacts or weight bearing increases bone density. Meta studies show improvement in bone mineral density after walking at hip (1,3%) and spine (0,9%) in postmenopausal women [33].

Conclusion

There is no doubt that physical exercise has important role in older population life. Its positive effects on successful aging have a substantial support in research literature. However, physical activity in older age is not as common as expected. There are several obstacles related to that. Many elders believe that exercise is only for young people. Many suffer from multiple comorbidities as arthritis and other musculoskeletal disorders that affect their physical activity. Some may limit elders to exercise only at very low intensities (e.g. chronic heart disease, peripheral artery disease, chronic obstructive pulmonary disease, etc.). Important factor to promote physical activity in older population are physicians with their recommendations.

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ASSESING BIOMARKERS IN BIOLOGICAL FLUIDS OF HEALTHCARE WORKERS

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Keywords: Stress, homeostasis, allostasis, inflammation, heart rate variability, CRP, interleukin-6

Abstract. Stress is a condition in which homeostasis of the organism is at risk because of external or internal stressors. Stressor can be defined as any type of change that causes physical, emotional or psychological strain. Failure to eliminate interference caused by stressor establishes a new, altered stage of homeostasis – allostasis, characterised as difficult functioning due to chronic and inefficient effort to neutralise stress. A recent data based on a long-term observation showed that healthy workers who were exposed to stress at work displayed significantly elevated inflammatory parameters and faced an increased risk of cardiovascular diseases. Doing sports regularly significantly reduced inflammatory activity, but only sports training is not enough to eliminate an influence of work stress on cardiovascular diseases. Aditional stress-relieving methods and integrated approach may be required. From that perspective, a homeostasis and homeostatic fragility is becoming an important concept in understanding chronic health changes (diabetes, chronic inflammatory disease, chronic infections, age-related changes) related to stress. A physiological impact of stress and/or reduced homeostatic reserve can be followed by a number of physiological markers:decline in muscle mass, relative increase in the proportion of fat, reduced glucose tolerance, poor control of blood sugar and lipids, basal metabolic rate, basal heart frequency, desreased heart rate variability (HRV), increased plasma level of inflammatory mediators (CRP, interleukin-6) and reduced plasma level of sex hormones. Among them, heart rate variability (HRV) is widely available marker of ‘‘sympathovagal balance’’ that predict autonomic reactivity to stress.

Introduction

Stress is a condition in which homeostasis of the organism is at risk because of external or internal stressors. Stressor can be defined as any type of change that causes physical, emotional or psychological strain. (1) Althought stress response is a powerfull and focused mobilisation of physiological homeostatic mechanisms (neuro-hormonal, cardiovascular, metabolic, inflammatory) to preserve homeostasis; the cost of stress-induced strain and response (energy loss, metaboilic, health and behavioral disturbances) may be considerable and even intolerable for an organism. Relatively mild stress-related disturbances may be well controlled by a harmless stress-induced excitation followed by apropriate adaptation responses (emotional, behavioral, physiological. The opposite is true for stress response, which fails to neutralize disorder – due to its excessive intensity or weak/inefficient adaptation/homeostatic response. If stressor persist, organism is experiencing chronic damage because of uncontrolled stressor and additionally because of physiological cost of chronic stress response (hormonal, metabolic, emotional, behavioral, social disorders). (2)

Failure to eliminate interference caused by stressor (e.g. cold, social distress, harassment by others, overwork) establishes a new, altered stage of homeostasis – allostasis. Allostisis is characterised as difficult functioning due to chronic and inefficient effort to neutralise the cause of disorder (e.g. constant time pressure resulting in errors in the workplace) and on the other hand due to continuous and burdensome activation of stress response. Both, uncontrolled stressor and resulting chronic stress response require large amounts of additional energy (e.g. emotional self-control, constant attention and tension, unfocusness on current tasks, neglecting nutritional, social, recreational and other needs). Frequently associated metabolic disturbances (fats, glucose, inflammatory cytokines) also arise due to influence of stress hormones and changes in the functioning of the vegetative nervous system. (3)

Effort to maintain allostasis may exceed performance of the organis

Homeostatic fragility is becoming an important concept in understanding chronic health changes (diabetes, chronic inflammatory disease, chronic infections) and age-related changes in recent years. It is a physiological syndrome accompanied by reduced homeostatic reserve and less efficient neutralization of stressors due to weaker and less organized physiological mechanisms. The result is increased fragility of adverse changes and with it increased chance of health complications.

Altered state of homeostasis (allostasis) though enables maintenance of seemingly unchanged way of life, but the energy input to maintain altered allostatic state may overcome organism's capacity. For example, adrenalin activities, stimulants, sedatives or drugs are widely used remedies for temporary preservation of allostasis despite intolerable stress. Also intensive sports training may sometimes be considered as remedy to achieve allostasis despite uncompensated chronic stressor, e.g. overwork. A well programed sport trraining allow the body some extra capacity and vigor allowing relatively healthy and stable allostatic resistance to chronic overwork; however the energy input to maintain health is much higher. Hence a question raises, how long should an individual (determined for unavoidable age-related declination in physical abilities) maintains a state of forced training just to resists a health damaging stressor, e.g. overwork. In other words - when is the time to eliminate the stressor (e.g. overwork), if we do not want the stressor to eliminate us. (4)

Stressful situations at work can have a negative impact on the cardiovascular system and the metabolism.

A recent data from MONICA/CORA study, based on a long-term observation of more than 950 people showed that healthy workers who were exposed to stress at work displayed significantly elevated inflammatory parameters and faced twice the risk of cardiovascular diseases. (5, 6) The study found a clear association between stress, elevated concentrations of inflammatory marker CRP (C-reactive protein), and risk of cardiovascular diseases. Moreover, job stress led to harmful psychological effects such as depression and sleep disturbances as well as to unhealthy behavior, for example, physical inactivity. Doing sports regularly, for at least one hour per week, significantly reduced inflammatory activity. However, the differences in terms of risk of cardiovascular diseases between people who suffered from work stress and those who did not still remained – sports was not able to eliminate an influence of percieved work stress on cardiovascular diseases. Aditional stress-relieving strategy may be raquired.

Sports training ***and work stress***

Beside MONICA/CORA study, also Lawrence S et all in Cochrane Review from 2010 concluded lack of randomly controlled trials comparing the effectiveness of sports interventions to alleviate PTSD (post-traumatic stress disorder). The search identified only five studies, none of which met the inclusion criteria. Currently, there are no randomly controlled trials comparing the effectiveness of interventions that utilise sports to alleviate PTSD symptoms. This is despite the growing number of organizations that are delivering a variety of sport and game programs to traumatised populations. The financial, logistical and technical resources required for randomised evaluations of such programs may have precluded such evaluations to date. However, such evaluations are critical so that we can consider offering a wider scope of interventions than that currently offered by traditional trauma-related disciplines.(7)

Currrently it can be concluded that stressful situations at work have a negative impact on the cardiovascular system and the metabolism, however only sports training is not enough to eliminate an influence of work stress on cardiovascular diseases. Aditional stress-relieving methods and integrated approach may be required. From that perspective, a homeostasis and homeostatic fragility is becoming an important concept in understanding chronic health changes (diabetes, chronic inflammatory disease, chronic infections, age-related changes) related to stress. Homeostatic fragility is a physiological syndrome accompanied by reduced homeostatic reserve and less efficient neutralization of stressors due to weaker and less organized physiological mechanisms. By reducing homeostatic (health) reserves the state of robust homeostasis (typical for a healthy, young man) moves into the state of fragile homeostasis mostly due to exhausting impact of chronic diseases, aging and chronic stress together with the effort to resist and maintain alostasis. Further decrease of homeostatic reserve causes the state of chronically unstable homeostasis, where even a small disturbance can fatally disturbe the homeostasis. (3, 4)

Physiological indicators of stress

Several studies of chronic patients and elderly people have the purpose to define physiological parameters, markers of reduced homeostatic reserve of the organism. Among them the most significant are decline in muscle mass, relative increase in the proportion of fat, reduced glucose tolerance, poor control of blood sugar and lipids. Due to strenuous maintenance of allostasis, basal metabolic rate (relative to the maximum) is relatively increased - most of the available energy is consumed to maintain physiological allostasis, hence the lack of energy for other life activities. Also typical indicators of stress and/or reduced homeostatic reserve are increased basal heart frequency, desreased heart rate variability (HRV), increased plasma level of inflammatory mediators (CRP, interleukin-6) and reduced plasma level of sex hormones. Parameters of physical capacity (VO_2 max, the Cooper test, Conconi test) are significantly reduced. (8)

Since the allostasis, i.e. the adaptive response of the organism to a stressful agent, is produced by the joint activity of the central nervous system, the hypothalamus–pituitary–adrenal axis and the immune/proinflammatory system, stress has been studied by a variety of disciplines with differing research traditions. Among them, heart rate variability (HRV) is widely available marker of ‘‘sympathovagal balance’’ that predict autonomic reactivity to stress. The state-of-the-art reports the following evidences : (1) the heart period variability defined as the High Frequency (HF, range between 0.15–0.50 Hz) spectral component, is a marker of vagal modulation; (2) the heart period variability defined as the low-frequency (LF, range between 0.04–0.15 Hz) component is a marker of sympathetic modulation and (3) the reciprocal relation existing in the heart period variability spectrum between power LF band and power HF band is a marker of the state of the sympathovagal balance modulating sinus node pacemaker activity. (9)

Heart rate variability was found as usefull predictor of mortality in pre-hospital trauma patients. It was found that patients who died had lower pulse pressures and higher parasympathetic than sympathetic modulation compared to patients who survived traumatic injuries when the heart rate, arterial pressure and SpO2 did not differ. Morris et al. studied the correlation between heart rate variability and deteriorating physiological reserve (change in lactate values over time) in trauma victims. They found that 55.9% had decreased HRV and that deteriorating physiological reserve is associated with reduced HRV. These studies showed the importance of an intact autonomic nervous system on outcome in victims of severe trauma. (10)

Also in our study (11,12) we confirmed a valuble role of HRV in evaluation the effect of interhospital air and ground transportation of artificially ventilated neonates. Fifty-eight transported critically ill neonates tranported day- and night helicopter, or day- and night-ground transportation were followed by 24-hour holter electrocardiogram monitoring. Our results clearly demonstrated that higher HRV indices determine lower heart rate values and a shorter length of stay in the intensicve care unit compared to lower HRV indices. Studies on HRV in premature and mature infants clearly show the importance of a stable autonomic nervous system in infants during maternal care and feeding, and to enable the infant to adapt to external events, maintain homeostasis and conserve energy.

Since mobile applications are getting more and more important part of our lives, we aimed to develop mobile applications related to health and better life quality. A simple yet valid stress assessment tool would help to make anti-stress efforts more efficient. We aimed to focus on use of heart rate variability (HRV) for two points: (1) to provide simple but valid and reliable assessment of stress/relaxation and its follow up, (2) to analyze sleep quality as a major recovery mechanisms and a stress marker. Heart rate variability can be acquired with simple chest belt commercially available (e.g. Polar) and analyzed with smart phone.

Since the allostasis is produced by the joint activity of the central nervous system, the hypothalamus– pituitary–adrenal axis and the immune/proinflammatory system, stress has been studied by a variety of disciplines with differing research traditions. Among them, heart rate variability (HRV) is a widely available marker of ‘‘sympathovagal balance’’ that predicts autonomic reactivity to stress. It is possible to detect signs of inadequate recovery due to increased sympathetic nervous system activity and decreased parasympathetic activity. There is strong evidence that adverse psychosocial work conditions are negatively associated with ANS function as indexed by HRV. (11)

From the psychological side, personality traits (e.g. depression and anxiety) are linked to hypothalamic-pituitary-adrenal axis activity. Furthermore, HRV is related to stress/relaxation personality traits. The sympathovagal balance is most reliably recognized with HRV during sleeping when other HRV influences are diminished4. High job demands and low job control are predictors of poor sleep quality5. With heart rate and HRV it has been shown that in hospital employees better recovery during nighttime was associated with higher resources the next day (12).

Conclusion

Stressful situations at work have a negative impact on the cardiovascular system and the metabolis, however only sports training is not enough to eliminate an influence of work stress on cardiovascular diseases. Aditional stress-relieving methods and integrated approach may be required. From that perspective, a homeostasis and homeostatic fragility is becoming an important concept in understanding chronic health changes (diabetes, chronic inflammatory disease, chronic infections, age-related changes) related to stress. A physiological impact of stress and/or reduced homeostatic reserve can be followed by a number of physiological markers:decline in muscle mass, relative increase in the proportion of fat, reduced glucose tolerance, poor control of blood sugar and lipids, basal metabolic rate, basal heart frequency, desreased heart rate variability (HRV), increased plasma level of inflammatory mediators (CRP, interleukin-6) and reduced plasma level of sex hormones. Among them, heart rate variability (HRV) is widely available marker of ‘‘sympathovagal balance’’ that predict autonomic reactivity to stress.

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MIND AND LIFESTYLE

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Abstract. Unhealthy lifestyle is normally associated with lack of physical activity, risky lifestyle, unhealthy diet and lack of health care. But on the other hand, usually people are not familiar with fact that their mind patterns and way of thinking may cause negative feeling and emotions, which enhance stress and can lead to psychosomatic disorders and can affect or maintain the lifestyle and quality of life. Psychosomatic diseases are condition in which mental stresses adversely affect physiological functioning. Modern psychological paradigm links the relationship between thoughts, feelings, behavior and physical symptoms, where all factors interact with each other. In the review article we try to present how thoughts and emotions affect the physical and psychological well-being, and how people can manage stress through mind control, using biofeedback technique and positive self-talk. Optimism and positive thinking are currently very popular topics and positive psychology research and application, so we will try to identify the implications of optimism and pessimism on individual`s health and well-being. We want to highlight the importance of self-regulation mechanism and thoughts and emotional control.

Introduction

Stress, emotions, negative thoughts, psychosomatic diseases, optimism and power of positive self-talk. What do these terms have in common? These words are often use when we try to define relation between mind, general health and well-being. Positive-self talk may lead to positive emotions and well-being, while stress can trigger negative emotions and lead to many different psychosomatic diseases. When we talk about psychosomatic diseases we mean a physical disease that is thought to be caused, or made worse, by mental factors, especially by out negative and dysfunctional minds. Due to the strong influence of human`s mind it is necessary that people are aware of their impact. Correction of dysfunctional thoughts and negative core beliefs about themselves can affect the quality of individuals' life.

In this article we will try to define the meaning of all these phenomena and determine how to affect a person.

Cognitive Triangle: Thoughts- Emotions- Behavior

The basic premise of cognitive theories is that they are not events themselves important, but it is our perception, interpretation and experiences of an event those whose effects on person`s emotional, behavioral and physiological responses.

Father of cognitive therapy Beck have noticed, during his psychotherapy with depressed patients, that the key to success of therapy belong to clients interpretation of certain events, situations. At the same time Becks found thinking patterns of depressed people have many specifics, which he called cognitive distortions. In his opinion cognitive distortions may cause and maintain depression [1]. His findings had soon spread to the anxiety disorders and today it is accepted that many disorders are maintained with negative and dysfunctional thoughts.

In certain situation every single man can differently interpret situation. The way people think about certain situation influences on how they feel and how they behave. Triggering event elicit person's mind interpretation, behavior and emotional feelings. All three factors have an impact on each other. This 'vicious circle' can make person feel worse. Person`s behavior can even stimulate different situations, which only heighten the feeling and influence on thought and interpretation on situation, what can make feel worse or better, depend on value of thoughts (positive or negative).

In addition to depression and anxiety disorders dysfunctional thinking can affect the well-being and is reflected as stress and can leads to different psychosomatic diseases. Epidemiologic research shows that exposure to severe environmental stress often is associated with persistent mental distress years afterward [2]. Environmental stress and it`s interpretation may cause functional dysregulation of the neuroendocrine system, which may weaken the immune system and, thus, lead to disease vulnerability [3]. Hypertension, electrocardiographic findings, chest roentgenogram results, pulmonary functioning testing can be caused by chronically stress [4]. Even researches on Vietnam veterans shows they had more health problems, and reported themselves to be in poorer general health after exposure to severe stress [5].

How Emotions and Mind Can Influence On Body Sensations

The cognitive triade of mind-emotions-behavior can be expanded to another large field, the physical reactions. Just as the pioneers of stress research stated, one's perception of stress depends on his subjective evaluation of it [6], of his thoughts and interpretation of them. Every perceived information about broken homeostasis triggers the specific physiological response. Stress and mental stress cause the activation of the hypothalamus in the brain, which increases the level of adrenal gland hormones (adrenalin, noradrenalin and cortisol) through the action of pituitary gland. Our senses sharpen, pupils dilate, hair bristles and we become more sensitive to information from our environment. Cardiovascular system activates. Increased respiratory activity provides higher levels of oxygen intake and increased heart rate enables faster oxygen transit to the muscles [7]. The level of energy consumption rises, so the system activates the glucose stored in liver. The blood vessels leading to kidneys and gastrointestinal tract constrict and slow down the systems that are not crucial for the fight or flight response to stressor. The blood vessels in skin also constrict to minimize every potential blood loss; sweat glands open and enable more efficient cooling. Body releases endorphins, which have the function of pain killers, so we feel less pain [8]. These symptoms are maladaptive for the optimal functioning of the autonomous nervous system; they affect one's psychological state and destabilize his behavior. Anxiety and stress can also raise muscle tension, affect respiratory functions, cause dysrhythmias, gastrointestinal disorders, chest pain, high blood pressure, difficulties swallowing, nausea, hyperventilation, tense or cramped muscles, fever, shivers, sweating and more frequent urinating [8].

People are usually aware of problems in physical level and rarely find their thoughts and feelings can be those effecting negatively on theirs body. For example, on reviewing the panic attack while eliminated organic causes of attacks, it is hard for people to understand that their thoughts were those which triggered panic attack (under specific environmental situation). Panic attack is characterized by specific physical response as hyperventilation, palpitations, excretion of adrenalin, muscle tension and other physical states. It is similar for people with anxiety disorders. They complain about physical signs such as tension in chest, trouble with sleeping, restlessness, physical tension, redness, flushing. Because people are not aware of the influence of thoughts and emotions on physical sensations, they usually interpreted and connect them with many other external factors not knowing that their thoughts can be so powerful.

Using Thoughts to Control Body Sensations with Biofeedback

Modern technology has allowed the development of a variety of devices which can measure body response under stress and response on certain mid. First known device measuring physiological response was polygraph and was invented in 1921. Today we know many different devices as biofeedback, neurofeedbcak for measuring body response and brain activity.

Biofeedback is a technique use for learn to control body's functions by controlling our mind. By controlling mind, calm breathing and relaxing certain muscles can lead to reduce somatic symptoms of stress and anxiety. Using biofeedback person is connected to electrical sensors, measuring heart rate, galvanic skin response, fingers temperature, breathing rhythm and muscle tension (depends on device). Device provides feedback information about physiological states, so participant can monitor how it changes by different situation. For example, a participant may deliberately elicit negative thoughts, worries, doubts, and watch how the body reacts to them.

Most participants who benefit from biofeedback are trained to relax and modify their mind and behavior. We believe that learn how to relax and control thoughts (which can cause tension) is a key component in biofeedback treatment of many disorders, particularly those brought on or made worse by stress.

Biofeedback training was shown as effective in in the treatment of urge incontinence [9], reducing anxiety and symptoms of anxiety [10], chronically muscle pain, neck and shoulder pain [11], posttraumatic stress disorder [12], depression [13], heart disease [14], headache and other stress related issues [15].

In our own research with elite basketball payers we provide three month long psychological preparation for competition in which we include different techniques of controlling negative thoughts and using positive-self talk ad biofeedback. After mental training we track individual`s performance in game and compare it with games before mental training. We found significant differences in better performance efficiency [16], self-confidence have increased [17] and somatic aspect of pre-competition anxiety was reduced [16, 17].

Role of Positive Suggestions

The most interesting thing about our core believes and automatic thoughts is that people believe in they are absolute reality and think they have good evidences for their beliefs. But in fact people are often very selective in the evidence that they focus on (or what they believe to be "fact"). A person with low self-confidence may remember a lot of situations in which he was not successful or had failure. Therefore, he may conclude, "I knew, I am worthless". This can lead to increase symptoms of anxiety and is also reflected on physical level.

Self-talk can be define as »an internal dialogue in which the individual interprets feelings and perceptions, regulates and changes evaluations and convictions and gives him/herself instructions and reinforcement« [18]. Its purpose is mainly self-regulation and consists of statements which are not meant for others to hear, but just for oneself [19]. Self-talk as mind flow can be either positive or negative and can have different impact on the individual.

Negative self-talk is usually self-critical or represents one's inability to succeed (e.g. »Why did I do that?«) and can produce anxiety, be counterproductive, inappropriate and irrational. Contrary positive self-talk is said as a form of praise, used for encouragement and implies the possibility of success (e.g. »Keep up the good work«). Most common type of self-talk is neutral, which is neither positive or negative in its nature (e.g. »Relax«) [18, 19]. Self-talk can be overt, external and available for others to hear, or covert, internal voice inside one's head [19]. Some individuals refer to themselves in the first person (e.g. »I can do this«), others in the second person (e.g. »You can do this«).

Individuals use self-talk in order to enhance motivation and attentional focus, direct and redirect attention, work on their goals, control and organize their thoughts, increase their level of self-confidence, control anxiety, regulate their arousal level, psych themselves up, maintain or increase their level of drive, regulate their effort level, control their cognitive and emotional reactions, prevent or relieve boredom, or for relaxation and general encouragement purposes [18, 20]. It takes time and practice for individual to learn how to use verbal cues in most effective ways [19].

As psychologist we should focus on persons mind and should be aware of their influence. What we say to ourselves influences our behavior in number of ways, so self-talk has a great impact on our actions – focusing on the desired thought leads to desired behavior. Individuals whose use more self-talk are usually more successful, but it's important to avoid using it too often, because overanalyzing can be counterproductive [19]. It has been proved that positive self-talk can improve performance, facilitate learning, enhance self-confidence and reduce cognitive and somatic anxiety [18,20].

Optimism, Pessimism and General Health

Positive thinking is based on positive expectancies for the consequences of one's actions. These expectancies, generalized, are relatively stable across time and context and constitute a dimension of personality that is referred to as optimism, the belief that good things will generally occur in one's life, contrary to pessimism, the belief that bad things will generally occur in one's life [21]. Optimism and pessimism can be viewed as either one bipolar dimension or as two separate dimensions. It is estimated that about 25% of the individual differences in optimism-pessimism is inherited. Optimistic or pessimistic behaviors are also partly learned from prior experiences with success and failure and through parental modeling and instructions in problem solving [21]. There are different kinds of optimism and pessimism and their benefits and costs vary across different individuals, situations, life span and cultural context [22].

Although optimism is usually »good« and the pessimism is usually »bad«, reality is much more complex than that. Different behaviors are more or less adaptive depending on situation and context in which they are used [21]. Too optimistic individuals may decrease their chance of success by just sitting and waiting for something good to happen. Optimism is also deconstructive in situations that are uncontrollable or evolve major loss. Pessimism on the other hand can also present the advantage. Pessimism has a positive function of helping anxious people manage their anxiety so that does not interfere with their performance [22], but can decreases motivation and lead to self-fulfilling prophecy. Despite optimism and pessimism we should consider person`s attribution. How individual attributed reasons for the events; is responsible by himself or are caused by external factors and does he or believe that things can be changed or not.

Optimists and pessimists use different ways of coping with stress. Optimists usually use more adaptive strategies: they are more likely to take direct action to solve problems, are more planful and focused and more likely to accept the reality of the situation. They try to make the best of it and grow personally from negative experiences. Pessimists are more likely to deny that problem exists and try to avoid dealing with it. When facing difficulties, they are also more likely to quit trying [21]. These different ways of coping influence the amount of one's distress in stressful situations, the nature of his thoughts, emotions and physical reactions. Higher optimism is related to higher life satisfaction, higher levels of subjective well-being during stressful times and lower negative mood levels [21, 23]. Optimism is also beneficial for one's physical well-being and health status. More optimistic individuals report fewer symptoms and complaints and rate their health as better than pessimists, they have more positive health habits, are more likely to take exercise, visit the doctor less, have lower blood pressure and better immune functioning, which means optimism influences longer-term health. Optimism and pessimism also predict depressive symptomatology [23].

Optimism and positive thinking are currently very popular topics in positive psychology research and application, but it needs to be taken into account that people use very different pathways for making positive progress in their lives and achieving goals, which differ across multiple circumstances and adaptation to them [22], so we should not favorites one of them.

Conclusion

According to the research findings, we can conclude that the negative and dysfunctional automatic thoughts play an important role how people experience stress and may even amplify negative feelings. Individual's thinking pattern is a habit, which is formed from early childhood on; such patterns are very stable and are often difficult to change. Some individuals are able to make changes by themselves, while others may seek for professional help, usually in the case when individuals have formed dysfunctional and negative core beliefs, not only negative thinking patterns. Besides the impact of thoughts and feelings, general health and well-being may be influenced by a myriad of other factors, such as past experience, previous diseases and other external factors, as well as other internal factors like motivation, personality structure and individual`s social skills. It is difficult to unequivocally claim thought are responsible for psychosomatic diseases but they can reinforce or reduce the problems. There is opportunity to teach people to understand the relationship between their mind and body sensations, what could help them to cope with different stressors.

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Optimal Feeling States and Performance: An Individualized Approach

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Keywords: Psychobiosocial feeling states, emotion-centered, action-centered coping, IZOF model, athletic performance, stress tolerance.

Abstract.
This presentation will examine emotional and non-emotional experiences related to individually successful and unsuccessful performances within the framework of the Individual Zones of Optimal Functioning (IZOF) model [1, 2]. In elite sport as a high achievement setting, positive and negative emotions should not be limited to the traditional characterization of well-being and ill-being. Both positive and negative emotions describe also well-functioning (P+ & N+) and mal-functioning (N- & P-). In other words, unpleasant emotions are not always functionally harmful and pleasant emotions are not always functionally helpful (beneficial) for athletic performance. Thus in high achievement setting, there is a clear need to focus on both well-functioning and well-being. Stress tolerance is one of the key factors in understanding helpful and harmful effect of emotions. Specifically, some expert performers are aware of the unavoidable effects of typically harmful emotions. They accept and are able to tolerate these effects by deliberately practicing and using specific coping strategies. At the same time other athletes may be unaware of helpful and harmful impact of emotions and fail to accept them as unavoidable experiences that need to be coped with. Among new promising directions of research on optimization of athletic performance is the analysis of the *psychobiosocial* (PBS) feeling states and emotion- and action-centered coping strategies. The notion of variability as applied to action process can be used in the analysis of a wide range of subjective experiences. Another useful notion is that emotion and action variability suggests the existence of several optimal states (the zone principle extended) rather than a single state. Apparently, more research is needed to examine if approaches tested empirically in sport may be beneficial also in other high achievement settings such as business, management, education, and healing settings.

Introduction

Consistent excellence is a priority in any high-achievement setting including professional and top level sport. Competitive stress and situational anxiety have been a popular research topic and area of applied work for decades. Predominantly nomothetic (*group-oriented*) approaches were favored until quite recently, although the renewed interest in idiographic (*individual-oriented*) approaches has also been witnessed [2, 3, 7]. Another limitation coming from the healing and partly educational settings is the overemphasis on notion that positive (pleasant) experiences by definition are positive and thus is almost always beneficial for all participants. On the other hand, unpleasant (negative) experiences are almost always detrimental for the performers. Research was focused until quite recently on negativity and coping with weaknesses rather than on enhancing individual strengths. In the sections that follow, I will examine the findings within the framework of the *IZOF model* as an individualized approach to understanding performance related experiences.

The Individual Zones of Optimal Functioning (IZOF) Model

This paper examines emotional and non-emotional experiences related to individually successful and unsuccessful performances within the framework of the Individual Zones of Optimal Functioning (IZOF) model [3, 4]. The IZOF model was developed in high achievement setting and focused on enhancing strengths rather than on healing weaknesses. Specifically, there is strong empirical support for the notion that positive and negative emotions should not be limited to traditional characterization of well-being and ill-being. In high achievement setting, both positive and negative emotions can describe both well-functioning (P+ & N+) and mal-functioning (N- & P-). In other words, unpleasant emotions are not always functionally harmful and pleasant emotions are not always functionally helpful (beneficial). Thus in high achievement setting, there is a clear need to focus on both well-being and well-functioning.

Competitive Anxiety & Anger

To understand coping and to evaluate its effectiveness, we need to know what the person is coping with [3, 5] and how does the target of coping affect the process of coping. This presentation takes the perspective of the IZOF model, which was initially proposed to examine pre-competition anxiety and later elaborated for research of emotion-performance relationships in sport. Briefly described, the findings suggest that anxiety and other negatively tuned stress-related emotions, as anger can be beneficial for some athletes. Emotional experience (state-like, trait-like and meta-experience) is a component of *psychobiosocial* state which can be described along five basic dimensions: form, content, intensity, context and time. Individually optimal intensity of anxiety and performance level are used as criteria to evaluate if the current and anticipated anxiety should be reduced, increased, or maintained at a level that is optimal for the particular individual. Guidelines for *anxiety-centered* coping are proposed with the emphasis on emotion- and action-centered strategies that affect situational emotional experiences accompanying performance.

High inter-individual variability of optimal anxiety suggests that individual-oriented assessments and coping are preferable to group-oriented approaches. Research shows that about 65 % of athletes perform well if their anxiety level is either high or low [3]. The “in-out of zone” notion describes anxiety-performance relationships at the individual level and suggests that optimal intensity of anxiety (high, moderate, or low) produces beneficial effect on individual performance [6, 7]. Athletes perform up to their potential if their actual anxiety is within the earlier established optimal zones of intensity. If an athlete’s actual anxiety state is out of her optimal zone, she is likely to perform below her potential.

Functionally Optimal Emotional experiences

There is a relative consensus that effective coping requires individual-oriented idiographic approach and the process perspective [7, 14]. Research findings show that negatively-toned emotions are not always detrimental for athletic performance and positively-toned emotions (such as self-confident or being pleased) are not always beneficial for expert performers. Emotion-performance relationships are usually bi-directional: pre-event emotions have either beneficial or detrimental impact on individual‘s performance and on-going performance process affects mid-event and post-event emotional experiences. Accordingly, two groups of coping strategies are: *emotion-centered* coping aims to manage (master, reduce, or tolerate – [7, p.152] discrete emotions or global affect; whereas in *action-centered* coping, the athlete’s focus is on the optimization of task execution process [8]. From the intervention perspective, it is important to consider the fact that the athlete can effectively cope with a single emotion (such as anxiety, anger, or complacency) but the separate control of multiple emotions and the actions is still problematic. Reduction of degrees of freedom seems as one possible effective strategy to enhance emotion control.

Pleasant and Unpleasant Emotions & Feeling States

Both positively-tuned and negatively-tuned emotions can affect performance (action process and action outcomes) differently. However, it is recommended to consider the combined impact of these functionally optimal and dysfunctional experiences on performance. In individualized emotion profiling, the athletes often generate idiosyncratic labels (descriptors) that emotion theorists would not categorize as emotions. Similar problem is encountered in the examination of the items in several standardized emotion scales such as POMS, PANAS, and CSAI-2. Strictly speaking the items are not emotions but they are important experiences related to successful and unsuccessful performances. Dropping these "non-emotion" items would be missing important information about performance related experiences [2, 5]. Therefore, using these labels and to categorize them according to available form dimension categories may be an effective option in the individualized assessments [6, 11]. The IZOF model proposes eight such modalities that can accommodate these different experiences (see below).

Multidimensionality of Emotional Experiences

Emotional experiences (affective modality) are of course related to several other components of psychobiosocial state. These component labels with selected descriptors include *cognitive* (alert, focused, confused, distracted), *affective* (worried, nervous, happy, angry, joyful, fearful), *motivational* (motivated, willing, desirous, interested), *volitional* (determined, brave, daring, persistent), *bodily* (tired, jittery, restless, sweaty, painless, breathless), *motor-behavioral* (sluggish, relaxed, sharp), *operational* (smooth, effortless, easy, clumsy actions), and *communicative* (connected, related, in touch) modalities. The validity of these assumptions regarding multimodal description of PBS states were tested empirically in different sports [9, 11,12]. From this perspective, any experience can be categorized by its predominant form and the relations with other modalities and is termed as a *feeling state*. In reality performance related experiences are multimodal and include several components. The main intervention task here is to identify the core modality and core labels within this modality through which it would be potentially possible to control performance related experiences and actions. Apparently, research could benefit from the idiosyncratic description of different emotion content by compiling researcher-generated labels from existing emotion scales and athlete-generated markers. In anxiety-centered coping, for instance, the assessment of emotions other than anxiety is also recommended to capture the impact of different anticipatory and outcome-related emotions.

"Feeling States"

In high achievement sport, the individual-oriented approach is especially relevant and the content of emotional experiences is categorized within the framework of two related factors: functioning (success-failure) and feeling (good-bad). The four derived categories include *success-related* functionally *optimal* pleasant (P+) and unpleasant (N+) emotions and *failure-related* dysfunctional unpleasant (N-) and pleasant (P-) emotions. These four categories help to identify the idiosyncratic labels of emotional experiences relevant for performance and reflecting the readiness to perform from an athlete's perspective [1, 12, 13].

This emotion content categorization concurs well with suggestion to group 15 discrete emotions into four appraisal categories [7]. Anticipatory category includes *threat* emotions (worried, fearful, and anxious) and *challenge* emotions (confident, hopeful, and eager); whereas outcome category includes *harm* emotions (angry, sad, disappointed, guilty, and disgusted) and *benefit* emotions (exhilarated, pleased, happy, and relieved). Apparently, pre-competitive anxiety falls mainly into anticipatory (threat emotion) category. The mid-event and post-event experiences include intermediate or final outcome emotion (harm or benefit emotions) category.

At different stages of performance process (preparation, task execution, evaluation) a constellation of different emotions is experienced. The anticipatory category (P+ challenge emotions and N+ threat emotions) is functionally optimal prior to and during performance. In contrast, the outcome-related category (N- harm emotions and P- benefit emotions), is apparently optimal in post-performance situations, but is dysfunctional (distracting attentional resources) prior to or during performance. In other words, functionally, emotional and non-emotional experiences reflect the dynamics of athletic performance triggered by task, environmental and individual (organismic) constraints [14].

Stress Tolerance in Emotions

Considering the fact that competitive stress is unavoidable stress tolerance is an important coping skill for any expert performer. It is well known that stress tolerant athletes are usually aware of, accept, and deliberately use their knowledge and practical experience of dealing with helpful and harmful effects of both positively-tuned and negatively-tuned emotions [2, 9, 10]. Excessively sensitive athlete with low level of tolerance is often unaware about harmful and helpful effects of positive and negative emotions [6, 8, 10, 11]. He or she does not accept the situation as unavoidable and requiring positive action. Finally, such an athlete is too much concerned about potential harmful impact of emotions on performance and therefore underestimates the potential benefits of the situation.

Conclusion

This paper focused on two major myths that still exist in high achievement setting of elite sport. Individualized and idiographic approach to research provides sufficient empirical evidence that negatively-toned emotions can be situationally helpful for performance. Less obvious still is the notion that positively-toned emotions can be detrimental for consistent excellence if the success situations are not handled with care. Additional research is needed to examine the situational well-being, well-functioning, and their interrelationships. In high achievement setting, there is also a clear need to combine an individualized and nomothetic approaches.

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THE WHY AND WHAT OF SPORT ACTIVITIES FOR SENIORS

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Key words: elderly women, sport activities, motivation, sport preferences

Abstract. This paper evaluates involvement of seniors in sport activities, their motivation and preferences for it. Some adaptations may be needed so that people regardless of age or limitation of movement could be active and consequently enrich their lives. The strong drive to enter sport activity programs was identified as important for health, improvement of personal fitness level and social gathering. The study has indicated that most practiced activities among elderly women were various ways of walking, cycling and swimming. Spending time on walking is close to being a regular every day event. Important changes happened with elderly women who were active in sport for a longer time. They found new challenges and more personal interest in how they looked, enjoyment and having fun. Better knowledge of the motivational structure and preferred sport activities of seniors could help to extend the creation of free time programs and its implementation into community centers and contribute to the quality of life of a wider population of the elderly. Data for the present paper is based on partial evaluation of the project *Sport for Healthy Life (2006/7 – 2011*) where 64 women (ages 66 – 78) from the Central region of Slovenia take part.

Introduction

Sport itself is a kind of adventurous event. This characteristic gives it a position of an attractive, exciting and unpredictable activity, which attracts all generations. It is known that the starting point for sport participation, and also why choosing particular sports disciplines, in many cases depends on the decisions made during childhood and adolescence. While the young people do the sport for fun and body development, the grown ups wish to maintain the body shape and strength, the elderly hope to slow down the aging process [1]. Daily activities are important for the elderly and have positive consequences on safety and independence in home environment [2]. When choosing their favorite free time activities, the elderly face both objective and subjective barriers. For the elderly population, active participation in free time activities contributes to greater independence, a fundamental factor in everyone's life. Older individuals who were physically active were more than twice more likely and those with moderate levels of activity were over one and a half times more likely to be ageing successfully than respondents who were not physically active [3]. The most popular activities among seniors were cycling, walking, swimming, and gardening [4]. An overview of the sports activities of the Slovenian women proves that the most frequently practiced activities were walking and strolling (27%), swimming (20%), cycling (18%), mountaineering (14%), aerobics (12%), dancing (12%), morning gymnastics (12%), badminton (10%), running (9%), and alpine skiing (8%) [5]. Active physical involvement of the elderly significantly contributes to the health status, longer living, functional abilities and subjective well-being [6].

Among grown up Slovenians in 2009, there were 23% inactive persons according to sport participation in their free time, while results for the European Union show the equivalent of 39% [7]. In Slovenia [8] 20% of women and 18% of men over 65 are practicing sports on a regular base. In the United Kingdom 10% of older adults (65+) are sufficiently active [9] in United States this rate was 21.8% [10]. A higher rate of sufficiently active older adults is observed in Australia, 55% [11]. Findings suggest that being physically active might not only have health benefits for older persons, but also leads to lower health-care costs [12]. The traditional excuses among ageing women and men for not being involved in sport related activities range from 'I am O.K. without sport,' 'I don't have enough time,' 'I have other hobbies,' 'I don't have enough money,' 'I don't find friends suitable for practicing sport together,' 'Sport makes me tired' to 'Sport activity had no positive effect on me' [13]. Such excuses of the elderly for not taking part in the sport related activities are de-motivational factors [14]. The health related quality of life of older adults is associated with both the intensity and the total volume of habitual physical activity undertaken and is significantly poorer in physically inactive older individuals [15]. Strength and endurance for elderly could be gained through activities such are walking, strolling, stationed biking, housework, gardening, play with children, swimming and running with speed of 7 km/ per hour [16]. Various researchers reported the unquestionable contributions and benefits of physical activity for the elderly regarding the cardio-vascular and muscular system [17], bone mass [18], arteriosclerosis [19], thrombosis [20], cholesterol level [21] and diabetes type-2 [22]. Regular physical activity is also extremely important for the mental health of the elderly [23]. Socio-cultural situation should be considered also when designing interventions, for example walking, to increase the physical activity in older adults [24]. Walking could keep sufficient mobility level for older adults and highly motivates older adults and fulfills their expectation to be physically active [25]. A study about the most desirable sports among elderly women in Slovenia showed that the most prevalent sports according to their wishes were extended from boccia, bowling, cycling, dancing, trekking, swimming, and volleyball to Nordic skiing, orienteering, and fishing [26]. A New Zealand research [27] identified three factors important why older adults participate in physical activities. Factor 1 related to participants being active for enjoyment reasons, factor 2 was related to participants being active for health and medical reasons, while factor 3 was labeled engagement-based reasons, consisted of items that related to how participants engaged in physical activity for the purpose of wanting to be physically active.

What kind of sport activities elderly women select

The research sample consisted of a total of 64 elderly women: 32 women aged 65 to 78 from the town of Kamnik who joined the project *Sport for Healthy Life (2006/7 – 2011)* and a group of 32 women aged 65 to 75 from the town of Kranj who did not join the project (control group). Both towns are located in central Slovenia.

Table 1. Structure of sport related activities among elderly women from the project *Sport for Healthy Life* in 2006/7.

Activity	GR	Hours per week								χ^2	p
		Not practicing or less than 1 hour		1 – 4 hours		5 – 8 hours		More than 8 hours			
		N	**%**	**N**	**%**	**N**	**%**	**N**	**%**		
Aerobics	PG	28	87.5	4	12.5	-	-	-	-	2.102	0.552
	CG	29	90.6	3	9.4	-	-	-	-		
Fitness	PG	26	81.2	6	18.8	-	-	-	-	0.702	0.704
	CG	30	93.8	2	6.2	-	-	-	-		
Cycling	PG	19	59.4	10	31.3	2	6.2	1	3.1	3.200	0.866
	CG	24	75.0	5	15.6	2	6.2	1	3.1		
Fast running	PG	28	87.5	4	12.5	-	-	-	-	0.008	0.927
	CG	30	93.8	2	6.2	-	-	-	-		
Slow running	PG	26	81.2	6	18.8	-	-	-	-	2.216	0.529
	CG	29	90.6	2	6.2	1	3.1	-	-		
Fast walking	PG	18	56.3	12	37.5	2	6.2	-	-	12.723	0.122
	CG	20	62.5	7	21.8	4	12.5	1	3.1		
Slow walking	PG	15	46.9	13	40.6	4	12.5	-	-	9.542	0.299
	CG	7	21.8	21	65.6	2	6.2	2	6.2		
Mountaineering	PG	14	43.8	16	50.0	2	6.2	-	-	16.455	0.021
	CG	28	87.5	4	12.5	-	-	-	-		
Walking in nature	PG	4	12.5	20	62.5	7	21.9	1	3.1	9.334	0.407
	CG	4	12.5	20	62.5	5	15.6	3	9.4		
Swimming	PG	20	62.5	11	34.4	-	-	1	3.1	8.320	0.040
	CG	31	96.9	1	3.1	-	-	-	-		
Bowling	PG	29	90.6	3	9.4	-	-	-	-	3.339	0.068
	CG	32	100	-	-	-	-	-	-		
Dancing	PG	27	84.4	5	15.6	-	-	-	-	4.167	0.244
	CG	31	96.9	1	3.1	-	-	-	-		
Golf	PG	29	90.6	3	9.4	-	-	-	-	3.339	0.068
	CG	32	100	-	-	-	-	-	-		
Yoga	PG	29	90.6	3	9.4	-	-	-	-	3.339	0.068
	CG	32	100	-	-	-	-	-	-		
Alpine skiing	PG	28	87.5	4	12.5	-	-	-	-	4.524	0.033
	CG	32	100	-	-	-	-	-	-		
Cross country skiing	PG	28	87.5	4	12.5	-	-	-	-	3.352	0.187
	CG	31	96.9	1	3.1	-	-	-	-		
Skating	PG	29	90.6	3	9.4	-	-	-	-	3.339	0.068
	CG	32	100	-	-	-	-	-	-		
Roller skating	PG	29	90.6	3	9.4	-	-	-	-	3.339	0.068

	CG	32	100	-	-	-	-	-	-		
Horseback riding	PG	29	90.6	3	9.4	-	-	-	-	3.339	0.068
	CG	32	100	-	-	-	-	-	-		
Boccia	PG	28	87.5	-	-	-	-	4	12.5	4.524	0.033
	CG	32	100	-	-	-	-	-	-		
Oriental dancing	PG	31	96.9	-	-	-	-	1	3.1	1.079	0.299
	CG	32	100	-	-	-	-	-	-		

LEGEND: GR – group, N – Number, % – percentage, PG – project group, CG – control group, χ^2 – Chi-square, p – significance

Table 1 offers a comprehensive overview of the sport activities that elderly women do most frequently. In the current study we found four sport activities, which statistically significantly differentiate both groups: mountaineering, swimming, alpine skiing and boccia. Except for boccia the mentioned sports are so-called Slovenian national sports and are practiced among the project group members more often. Results of the control group showed that boccia, oriental dancing, horseback riding, rolling, alpine skiing, yoga, golf, skating and bowling are more or less unpracticed. Explanation for low participation is that certain risk factors such as injury and lack of partners' support prevail. The study has also indicated that most practiced activities among elderly women were different forms of walking in nature, cycling and swimming where spending time on mentioned activities is close to being a regular every day event. Researchers confirm [28] that walking in nature, cycling, swimming, mountaineering and alpine skiing are the favorite and most practiced sports activities among Slovenian adults. Australian women aged 75 to 81 preferred swimming, cycling and walking [29]. Walking is known to be the most common type of activity for older adults The American College of Sports Medicine [30] stated that aerobic endurance training can slow down age related physiological changes, reverse atrophy from disuse, help to control chronic conditions, promote psychological health and preserve the ability to perform activities of daily living. Varieties of walking as typical aerobic activities are well practiced among respondents from the project *Sport for Healthy Life in 2006/7.* We assume that elderly women know very well the benefits of being active and therefore take the opportunities, which sport activities could offer.

Why elderly women enter the sport activities

Motivation for sport of elderly women and their preferable selection of sport activities could direct us towards more suitable approach of planning and introducing sport for all.

Table 2. Structure of motivation for sport activities among elderly women from the project: *Sport for Healthy Life* in 2011.

Motives	GR	Level of importance among motives for participation										χ^2	p
		1		2		3		4		5			
		N	**%**	**N**	**%**	**N**	**%**	**N**	**%**	**N**	**%**		
Good looking	PG	2	10,0	1	5,0	4	20,0	6	30,0	7	35,0	18,892	0,000
	CG	8	47,1	-	-	9	52,9	-	-	-	35,0		
Fun, pleasure	PG	-	-	1	5,0	1	5,0	4	20,0	14	70,0	39,979	0,000
	CG	7	41,2	-	-	8	47,1	1	5,9	1	5,9		
Better health	PG	-	-	-	-	1	5,0	2	10,0	17	85,0	1,044	0,314
	CG	-	-	-	-	-	-	1	5,9	16	94,1		
Cure of illness	PG	1	5,0	1	5,0	2	10,0	4	20,0	12	60,0	0,999	0,324
	CG	1	5,9	-		4	23,5	7	41,2	5	29,4		
Social life	PG	-	-	2	10,0	2	10,0	5	25,0	11	55,0	7,883	0,008
	CG	2	11,8	-	-	7	41,2	7	41,2	1	5,9		
Better physical fitness	PG	-	-	-	-	1	5,0	4	20,0	15	75,0	0,460	0,502
	CG	-	-	-	-	1	5,9	1	5,9	15	88,2		
Positive examples	PG	3	15,0	4	20,0	-	-	4	20,0	9	45,0	0,446	0,508
	CG	5	29,4	-	-	5	29,4	-	-	7	41,2		
Better strength, flexibility	PG	-	-	-	-	1	5,0	3	15,0	16	80,0	1,320	0,258
	CG	1	5,9	-	-	3	17,6	-	-	13	76,5		

LEGEND: GR – group, N – Number, % – percentage, PG – project group, CG – control group, χ^2 – Chi-square, p – significance, Importance of reasons for sport participation: 1 – not important at all, 5 – very important reason

When sport activity becomes a lifestyle of an individual, especially for the elderly, there is clear benefit from it. Better health and enhanced quality of life are figured as the general and most obvious motives for sport participation. Sport and its effects persuade many among elderly to get involved. We find that longer and active sport participation triggers some noticeable changes. Motives for sport participation named better health, physical fitness and social gathering remains important for all involved throughout the time of project *Sport for Healthy Life.* Table 2 indicates that elderly women who have been active in sport for a longer time find new challenges and motivation in looking good, having fun, enjoying social life and recognize positive examples for their own participation. The control groups of elderly establish their motivation for eventual sport activity on standard set of motives including healthy reasons, physical fitness and social gathering. Excuses for not being physically active older adults were due to a lack of motivation, feeling too old to be physically active and family responsibilities [31]. In order to maintain and increase physical activity levels of seniors, the reasons for participation and their changes through the years need to be understood.

Conclusions

As shown in this study, the reported structure of sport preferences and motivation for sport among elderly women helped increase awareness of the importance to be active. Activities connected with sport and consequently the structure of free time indicates the level of participation amongst elderly women in daily life. Successful applications of sports activities in elderly populations depend also on the respect of personal integrity, regional traditions and adaptation flexibility. Once elderly recognize the advantage of using their free time for sport related activities, they will be able to find sufficient time and motivation for practicing. The most frequently reported practiced sport was walking in various forms, for example walking in nature, fast walking, slow walking, etc. Despite some limitation of the study, small sample, measurement via self-report, the interpreted results reflect the structure of sport activities of elderly women in Central region of Slovenia. The obtained data also indicate that elderly women who are active in sport for a longer time find new challenges and motivation in looking good, having fun and enjoying social life and recognition of positive examples while the non regular sport active members establish their motivation for eventual activity on more standard sets of motives such are healthy reasons, better physical fitness and social gathering. Many of sport related programs for the elderly are much more efficient and easier for practicing with the help of volunteers. When people come into contact with others who are different from themselves, their stereotypes and prejudice will lessen as they come to understand the other person [32]. Our research findings could be a small contribution to better understanding of some aspects of seniors and their involvement in sport.

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BALANCE SPECIFIC EXERCISE PROGRAMS FOR THE ELDERLY

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Keywords: balance, multi-component balance exercise, elderly, falls, fall prevention

Abstract. The aim of the article is to describe a balance specific multi-component exercise program. This program is designed to increase balance and decrease risk for accidental falls with elderly communities as well as nursing home residents. The program is based on understanding of the neural control that underlies balance. Key components are biomechanical constrains, movement strategies, sensory strategies, orientation in space, control of dynamics and cognitive processing. By taking these key components into consideration, different features of balance are emphasized: 1) changing of ones center of gravity (CoG) position in a vertical direction, 2) shifting of the CoG to the border of stability, 3) rotation of the head and body about the vertical axis, 4) standing and walking on soft supporting surface, 5) walking over obstacles or on a narrow path and 6) multitasking.

The balance specific exercise program can be organized as circuit training and is typically performed in three stations. The tasks in different stations progressively increase balance demands. The balance specific exercise program has proven to be effective for balance enhancement and consequently to decrease one of major risk factors of falls. It is successful in for nursing home residents and community dwelling elderly. These balance specific exercise program is suitable equally for non-faller as well as for those with experience of falls.

Introduction

The population of EU member countries is projected for the period of 2008-2060 to become older where the median age of the total population is likely to increase in all countries without exception due to the combined effect of the existing structure of the population, persistently low fertility and a continuously increasing number of survivors to higher age [1]. In particular, the population aged over 65 years is expected to increase in all European countries, whereas Slovenia is predicted to be by the end of the third decade of this century already among the countries with the oldest population in the world with the increase of the population over 65 years from 16 % of the total population in 2008 to 25% in 2030 and 33 % in 2060 [1].

Accidental falls

The phenomenon of accidental falls is associated with increasing age and multiple causes contribute to unfortunate events. The contributing causes are divided into intrinsic and extrinsic risk factors [2]. The extrinsic factors result from a person’s environment such as thick carpeting, improper footwear, slippery surfaces, poor illumination etc. On the other hand the most often identified intrinsic factors are those related to the medication use, syncope, postural instability, loss of balance, visual impairment, muscle weakness and senso-motor deficit [2]. Falls among elderly community-dwelling subjects are reported to occur while walking on level or uneven surfaces [3] additionally the majority of falls occur when subjects perform an additional cognitive or motor function while walking [4]. The risk of accidental falls increases with ageing and the related reduction of physical ability. The prevalent consequences of accidental falls are hip and hand fractures, bruises, and pains

[5]. Accidental falls in elderly populations is becoming a serious health problem. According to Slovenian records in 2011, over 60% of total hospital treatments were a result of accidental falls [6]. In a population of 1000 persons, 36 in the age group 60 to 74 years experienced accidental falls and were consequently hospitalized whereas this numbers were 115 in the age group over 85 years. Falls in elderly quite often lead also to loss of independence, associated illness and diminished quality of life. They are not only harmful for the individuals but also present a great burden for the society as a whole.

Balance control

One of the most important risk factors for falls in old age is impaired balance [5]. To prepare efficient exercise program it is important to understand neural mechanisms that are responsible for balance control. Key components were described by Horak in 2006 [7] and are briefly described in the following paragraph. Key components of balance control as illustrated in Fig. 1 are biomechanical constrains, movement strategies, sensory strategies, orientation in space, control of dynamics and cognitive processing.

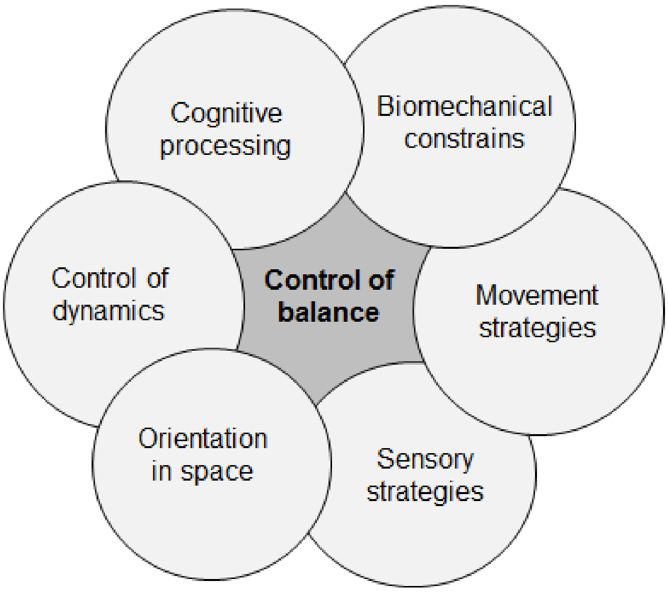

Fig1. The neural control of balance, based on system approach [8] emphasizing six key components involved in balance control [7].

The most important *biomechanical constrain* on balance is the size and quality of the base of support followed by the limitations of joint range, muscle strength and sensory information available to detect the limits. It is important for the CNS to have an accurate central representation of the stability limits of the body. Tree main types of *movement strategies* can be used to return the body to equilibrium in a stance position: the ankle strategy, the hip strategy and taking a step to recover equilibrium. The first two strategies keep the feet in place and the other strategy changes the base of support through the individual stepping or reaching. *Sensory strategies* are built in accordance with available sensory information from somatosensory, visual and vestibular systems must be integrated to interpret complex sensory environment. As subjects change the sensory environment, they need to re-weight their relative dependence on each of the senses. The ability to re-weight sensory information depending on the sensory context is important for maintaining stability when an individual moves from one sensory context to another, such as from well-lit sidewalk to a dimly lit garden. *Orientation in space* is the ability to orient the body parts with respect to gravity, the support surface, visual surround and internal references is a critical component of postural control. Perception of verticality may have multiple neural representations. In fact the perception of visual verticality, or the ability to align a line to gravitational vertical in the dark, is independent of the perception of postural (or proprioceptive) verticality, for example the ability to align the body in space without vision. *Control of dynamics* is required during gate and while changing from one stable position to another; it requires complex control of a moving body's center of mass. Finally c*ognitive processing* is a part of postural control. Many cognitive resources are required in postural control. Even standing quietly requires cognitive processing, as can be seen by increased reaction times in persons in standing compared with those who are sitting with support. Because the control of posture and other cognitive processing share cognitive resources, performance of postural tasks is also impaired by a secondary cognitive task [7].

With ageing a decline is expected in motor functions such as muscle strength and endurance, in flexibility, in acuity and in the amount of sensory information from different sensory modalities including the somatosensory and vestibular systems [7]. It is expected that a deficit in any sensory system reflects a change of the processing of sensory information and the resulting motor response and thus also in balance and posture. Redundancy of the afferent inputs of the visual, vestibular and proprioceptive systems is therefore essential for optimal postural control. During everyday activities it may happen that sensory information is conflicting and this may lead to loss of balance and even a fall. Such a case happens for instance when a subject is standing in a bus moving with constant speed - here the visual information is signaling movement whereas the vestibular and proprioceptive systems do not support it. The probability of falls in case of conflicting sensory information increases with the advancing age [10].

Balance specific exercise program

Strategies for fall prevention should address both, the intrinsic and extrinsic risk factors [11]. In the intrinsic risk factors domain, balance is an important risk factor for the falls among the elderly frail individuals as well as among the community-dwelling ones [5]. There is still no agreement between researchers about the type and intensity of training for the optimal enhancement or maintenance of balance function in elderly persons. The only agreement appears to be on a minimum of 50 hours of training the dose necessary for inducing change in balance function [12].

Therefore, a number of training protocols have been proposed to enhance or maintain balance into advanced age. Study results indicate moderate evidence that some exercise types are effective in improving balance [13]. General exercises may have beneficial effects on muscular strength and capacity, but quite often the influence on balance function is minimal [14], or completely absent [15]. These results suggest that the improvement of muscle capacity is not directly transferred to balance function [16]. For the community-dwelling older adult a progressive exercise program that focuses on moderate to high intensity balance exercise appears to be one of the most effective interventions to prevent falls [12].

A balance-specific exercise program is therefore an option to maintain or enhance balance in the elderly. To address the complexity of balance a multi-component exercise program is needed. The multi-component balance-specific program is designed in accordance with the system approach. This approach stresses the importance of the fact that any movement emerges from an interaction between the individual, the task and the environment in which the task is carried out [8]. It has been shown that balance-specific training with functional tasks that challenge balance is efficient in frail nursing home residents [17] as well as in functionally more able elderly [18, 19, 20, 21].

Basic components of balance specific exercise program

The balance specific activities are designed to emphasize different features of balance function. The components are: 1) changing of the center of gravity (CoG) position in the vertical direction, 2) shifting of the CoG to the border centrality, 3) rotation of the head and body about the vertical axis, 4) standing and walking on soft supporting surface, 5) walking over obstacles or on a narrow path and 6) multitasking. The concept has been described in detail elsewhere [22] and is introduced here in brief.

1. The first component is *changing of the CoG position in the vertical direction*. This component is required for transitions between different stable positions such as standing up and sitting down as well as for ascending and descending stairs. Transition between different stable positions as well as stair climbing is reported to be that activities during which high percentage of indoor falls occur [23]. For the shifting of the CoG in vertical direction a certain amount of strength of the thigh muscles is required. For stair climbing is besides strength required also a certain amount of aerobic capacity as well as accurate perception of depth.
2. The second component of the balance specific program consists of *shifting the CoG* to the border of stability. This skill is required when reaching beyond the arm length and is known to decrease in elderly subjects [24].
3. The third component requires *rotation of the head and body about the vertical axi*s. This skill is necessary for avoiding obstacles and while looking over the shoulder where head movement is followed by whole body axial rotation. This movement elicits the vestibulo-ocular response that is responsible for gaze stabilization and is closely related to postural control [24].
4. The fourth component consists of the activities while *standing or walking on a soft supporting surface*. This skill is for instance required for walking on thick carpeting or during some outdoor activities such as walking in meadows or woods. Adding a sensory component to functional balance training, especially in the form of compliant or movable surfaces, presents an additional challenge for the postural control system. Namely, standing on a compliant surface alters two types of sensory inputs from the lower extremities. The information from the soles is modified by different pressure distribution under the sole and thus differently affects the cutaneous mechanoreceptors in the foot [25], which are essential for determining the position of the center of pressure on the base of support. The other effect is dynamic - the elasticity of the supporting surface results in additional body movement, which requires constant adjustments of the relative positions of body segments to keep the center of gravity over the base of support [26]. Training on a compliant surface, which is occasionally also called proprioceptive training, is a type of senso-motor training. This training has been recently reported mainly in

rehabilitation after muscular, knee ligament and ankle injuries [27]. In the elderly the reported results of senso-motor training that includes training on compliant and moving surfaces are conflicting, some indicating that such sensory-specific training reduces the influence of mechanical destabilization on body balance [28] and improves inter-muscular coordination [19, 21] while others report no effect on postural sway [29].

5. The fifth component consists of *walking over obstacles or on narrow surfaces*. This kind of walking, while subjects put their legs in front of each other, requires more control in the hip region and enhances the training of hip strategy that has been reported as a prevailing balance movement strategy in elderly subjects [9].
6. The sixth component is *multi-tasking a* simultaneous performance of motor and cognitive task. During multitasking, when a person simultaneously performs two motor tasks or one motor and the other cognitive task a divided attention is required. Example of such activities during balance specific training program is dance. The learning of a new choreography typically require divided attention. Besides dance requires also memory, coordination of ones movements, attention to the music as well as to other dancers It has been reported that with training of dance elderly can maintain [30] as well as improve balance [31].

Organization of the balance specific exercise program

The balance specific exercise program is organized as a multi-component program. This term denotes an intervention that incorporates multiple components, such as the activities targeting performance (muscle strength, endurance and/or power), balance, postural control and walking or cardiovascular endurance. The first part of balance specific program is worming up. It consists of exercises that activate all major muscle groups of the body where elements of aerobics are introduced. Worming up includes also stretching of the major muscle groups. This part lasts approximately 30 minutes. The initial worming up is followed by the balance specific activities. These second 30 minute part of the program can be organized as circuit training and is typically performed in three simultaneous stations. The tasks progressively increase balance demands. In all training sessions there is training on a compliant surface and the other two stations can be chosen between: obstacle avoidance station organized as polygon, steppers, and seated activities on gym balls. The last activity is usually dance, mostly a group folk dance. Subjects spend between 8 to 10 minutes on each of the three stations. For safety reasons in this kind of exercise program one or two assistants are required on each station at all times.

The compliant surface exercise workstation aims at preserving and stabilizing balance in altered proprioceptive conditions. For these exercises 6 cm thick Airex™ mats of various dimensions and elasticity are used. The participants stand on them with both feet parallel, toe to heel, or on one leg. All these activities are repeated with open and closed eyes. Participants can also walk forwards, sideways and backwards on a 2 m long and 20 cm wide compliant mat. Stepping on soft and compliant small stepping surfaces can be also included. The exercises are adjusted to the ability of the participant and a useful way is performance in pairs or while touching a stable surface.

The workstation on steppers, as used for aerobics, is principally aimed at improving weight transfer and estimation of step height and included also a component of aerobic training. The height of the steppers is adjusted to 18 cm and this height corresponds to standard step height. The participants are stepping on steppers forward, sideways or over them. During the exercises program the frequency and the repetition counts are adjusted to the individual abilities.

The polygon with obstacles include walking on a compliant surface, stepping over obstacles of different heights, walking around objects of various sizes, 360 degree turning, walking while carrying objects and sitting on surfaces of different heights. This group of exercises the ability of changing the base of support and approaching its limits, vestibulo-ocular stabilization, changing the direction of movement and double attention.

The activities performed while sitting on a big gymnastic ball enables exercises on a moving base of support, it allows a constant changes of the size of base of support as well as the number of available fixed points. This group of exercises enable participants the training of proactive balance where the activities demands anticipatory postural adjustments and the reactive balance with the demands for reacting to the moving base of support.

Conclusion

The efficacy of above described multi component balance specific exercise program has the potential to enhance balance and to decrease one of major risk factors for falls was successful in for nursing home residents [17] and for community dwelling elderly [21]. The functional balance exercise program proved to be effective also in a group of participants who had fallen, namely preliminary results indicate that the program is suitable equally for non-faller as well as fallers [22] despite numerous differences between the two groups of elderly persons.

The balance specific exercise program was able to address the static balance, participants were able to stay longer in tandem stance [17] and their postural sway decreased on firm and compliant surface with their eyes opened and closed [21, 22]. The balance specific exercise program also resulted in significantly increased gate speed of nursing home residents [18], as well as the community dwelling ones [21]. Increase in gate speed indicates the transfer of balance skills from static to dynamic and from training site to functional situations.

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Linear and non-linear analysis of heart rate variability: are effects of carbohydrate ingestion and hypoxia gender-related?

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Abstract: The aim of the present study was to assess the gender-related effects of sucrose ingestion and normobaric hypoxia on cardiac autonomic nervous function (ANS) in young healthy males (n= 6) and females (n= 8). All subjects were exposed to normoxia (40-min). After the first 15-min normoxic period the subjects ingested a 10% water solution of sucrose in the amount of 4 kcal per kg body mass (4 kcal ≈1 g sucrose). Then followed 30-min acute normobaric hypoxia (FiO2 = 12.86%). During the experiment the ECG was continuously monitored. The cardiac ANS activity was evaluated by using hart rate variability (HRV) linear (autoregressive spectra) and non-linear (beta coefficient, fractal dimension) analysis. The HF spectral component showed a significant reduction of vagal activity ($p < 0.05$) in women but not in men, comparing normoxia to sucrose ingestion and hypoxia. At the same experimental conditions the LF/HF ratio as expression of sympathovagal balance presented a significant increase only in females. Also the fractal dimension, as expression of the complexity of the system, was significantly lower ($p < 0.05$) only in female subjects comparing normoxia to sucrose ingestion and hypoxia. These results indicate a different gender-related cardiac ANS modulation, linked to the carbohydrate ingestion and acute exposure to hypoxia, suggesting in females a higher sensitivity to both these factors able by itself, in particular conditions, to influence the sympathovagal balance.

Introduction

During acute exposure to hypobaric hypoxia a depression of autonomic functions as reflected in a decrease of heart rate variability (HRV) has been reported, and a shift in the sympatho-vagal balance towards relatively more sympathetic and less parasympathetic activity has been detected at higher hypoxic levels [1-3]. The carbohydrate treatment represents another factor able to influence the cardiac ANS function. It has been demonstrated that carbohydrate ingestion, but not fat or protein ingestion, increases sympathetic nerve activity [4-5]. A dominance of sympathetic over the parasympathetic modulation as expressed by higher value of LF/HF ratio has been observed in healthy subjects after glucose administration [6].

Methods

Fourteen young healthy subjects (8 females in the follicular phase of their menstrual cycle and 6 males) participated in this study. All subjects were students of average fitness, nonsmokers with no history of cardiovascular, metabolic or pulmonary disease. All participants gained physicians' approval and provided their informed consent for voluntary participation in the study. The protocol of the study was approved by the National Ethics Committee of the Republic of Slovenia.

To eliminate the effects of circadian rhythm, the experiments were performed in the morning at the same day-time in the laboratory situated at 90 m a.s.l. The subjects did not perform any physical activity on the day prior to the experiment or on the day of the experiment and they were instructed to not consume any food or drink (except water ad libitum) on the day of the experiment.

Continuous blood pressure measurements by applanation tonometry and electrocardiogram (Colin BP-508, Komaki City, Japan), as well as finger pulse oximetry (Nellcor Oximax N-550, Pleasanton, Ca, USA) were initiated. The subjects were also provided with a mouthpiece, which was connected to a pneumotach (Hans Rudolph, Wyandotte, MD, USA) on the inspiratory side to monitor breath-by-breath ventilation. The expiratory side of the mouthpiece was connected to a 3.5-L mixing box, from which a 150 ml/min sample of air was passed continuously to a O_2/CO_2 gas analyzer (Servomex 1440, Crowborough, UK). Upon instrumentation, ambient data were noted and subjects rested supine on an examination table for the rest of the experiment.

Each experiment was composed of a 15-min control normoxic period (first normoxia, NORM 1), after which the subjects ingested in less than a minute a 10% water solution of sucrose in the amount of 4 kcal per kg body mass (4 kcal ≈ 1 g sucrose). After the sucrose intake a rest period of 30 min started in order to allow enough time for carbohydrate absorption; no data were recorded during this time. Following a 30-min rest, the second normoxic interval of 10 min was recorded (second normoxia, NORM 2), after which the inspiratory side of the mouthpiece was connected to a meteorological balloon, which acted as a reservoir for a hypoxic gas mixture (FiO2 = 12.86%) and at the same time allowed for its humidification, as the gas mixture was passed through water. Inspiration of a hypoxic normobaric gas mixture is one of the standard procedures for stimulation of high altitude and in the present study served to simulate the altitude of 3,500 m [9]. The subjects inspired the hypoxic gas mixture for 30 min. The first hypoxic interval was recorded between the 10^{th} and the 20^{th} min (first hypoxia, HYPO 1) and the second hypoxic interval between the 20^{th} and the 30^{th} min (second hypoxia, HYPO 2). After 30 min of hypoxia, the subjects were switched to air and the experiment ended. During the experiments, ECG and oxygen saturation (SaO_2; %) were continuously monitored.

From the ECG, the series of consecutive R-R interval (tachogram) in function of beat numbers was extracted. All artifacts during the recording were removed by passing the time R-R series through a filter that eliminated premature beats (if deviated from previous qualified interval by more than 2*SD and substituted them with an interpolated value computed from the neighboring 10 beats. In order to sample at regular time intervals, the series were linearly interpolated and resampled at 2 Hz for further processing.

From the tachogram, spectral power was calculated by autoregressive modeling on intervals of 1024 points. Low (LF: 0.04-0.15 Hz) and high (HF: 0.15-0.40 Hz) spectral bands (in ms^2 and normalized units) were evaluated and the LF/HF ratio was derived. Linear regression analysis between log(Power) and log(Frequency) was performed on the power spectrum included frequencies between 0.004 Hz and 1 Hz, and the slope (β) was estimated. The fractal dimension (FD) was evaluated by means of the Higuchi's algorithm [10] based on the measure of the mean length of the curve by using a segment of ***k*** samples (***k*** varying from 1 to 6) as an unit of measure. Higuchi fractal dimension is a non-linear measure for estimating the dimensional complexity of biomedical time series. The FD values were calculated on tracts of 120 consecutive RR interval samples. The mean value of FD ± SD was considered in the analysis.

Statistical analysis

The differences among the four conditions (NORM 1, NORM 2, HYPO 1, HYPO 2) were considered for the statistical analysis, separately in males and in females. The Wilcoxon rank sum test for paired-data was applied and a p-value of 0.05 was adopted as statistically significant.

Results

In men the sucrose ingestion in normoxia provoked a statistically significant increase of FD comparing NORM 1 to NORM 2 (1.35 vs. 1.44 p = 0.04), whereas any significant difference was detected neither in RR interval (mean value + SD) nor in other HRV parameters. In women, in the same normoxic conditions (NORM 1 vs. NORM 2), the carbohydrate ingestion did not cause any significant modification of analyzed parameters.

Comparing normoxia to hypoxia, the differences between males and females become more evident. The ***males*** presented significant differences only for RR intervals comparing fasting normoxia to both hypoxic period after carbohydrate administration (RR interval: NORM 1 vs. HYPO 1, p=0.04; NORM 1 vs. HYPO 2, p=0.004) and beta coefficient (NORM 1 vs. HYPO 2, p= 0.01).

On the other hand, in ***females*** hypoxia without sucrose ingestion as well as hypoxia with sucrose ingestion provoked a statistically significant increase of heart rate, i.e. a significant decrease of RR interval (NORM 1 vs. HYPO 1, p= 0.002; NORM 1 vs. HYPO 2, p = 0.003, NORM 2 vs. HYPO 1, p= 0.03, NORM 2 vs. HYPO 2, p= 0.03) (*Fig. 1*), a significant decrease of HF spectral component (ms^2) (NORM 1 vs. HYPO 1, p=0.005; NORM 1 vs. HYPO 2 p=0.01, NORM 2vs HYPO 1, p=0.01, NORM 2 vs. HYPO 2, p=0.02 (*Fig. 2*). Also, a significant increase of LF/HF ratio was observed (NORM 1 vs. HYPO 1, p = 0.005; NORM 1 vs. HYPO 2, p=0.003; NORM 2 vs. HYPO 1, p=0.003; NORM 2 vs. HYPO 2, p=0.001) (*Fig. 3*).

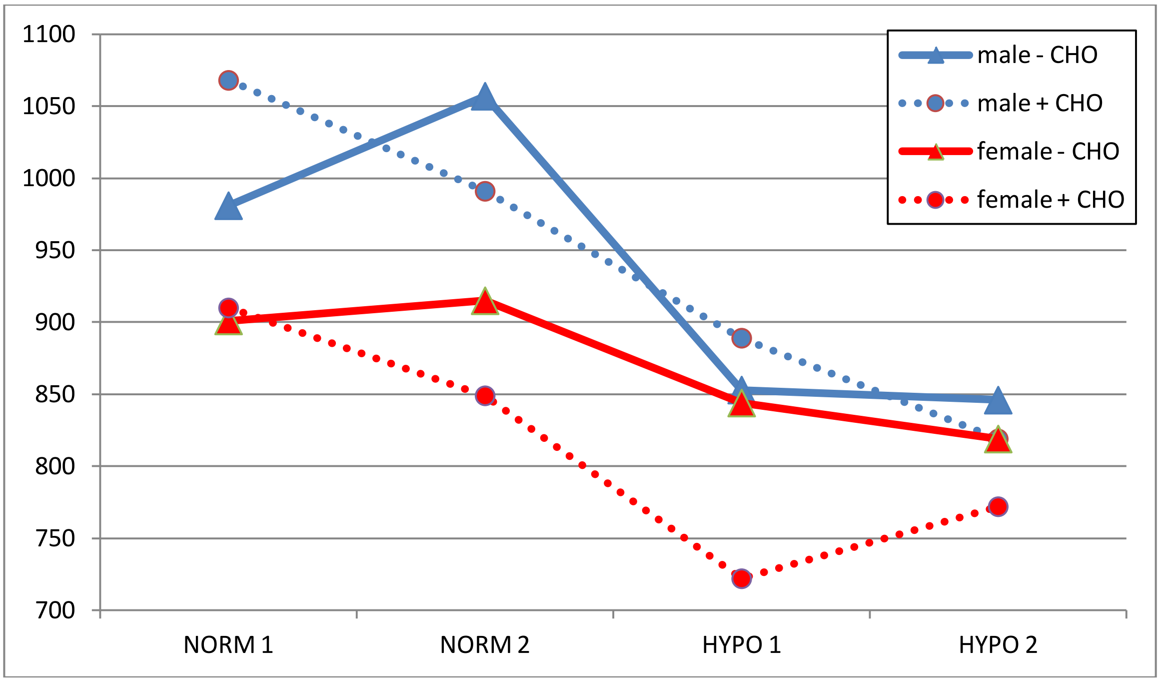

Fig. 1: RR intervals (ms) in four phases of experiment

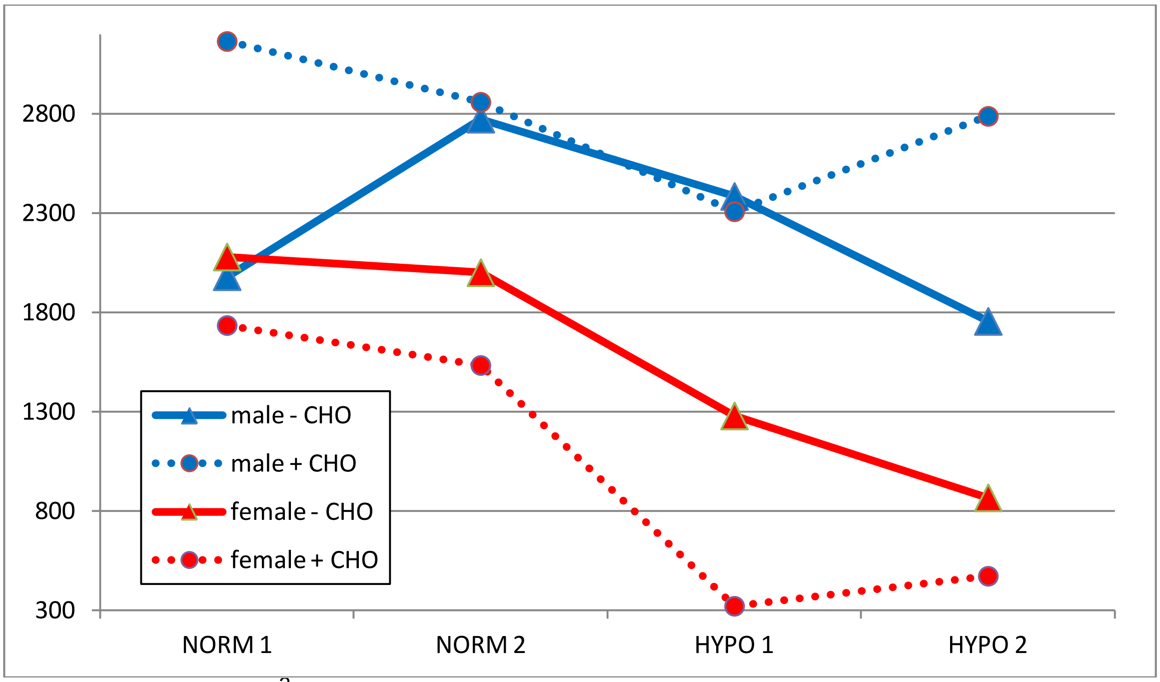

Fig. 2: PSD-HF (ms^2) in four phases of experiment

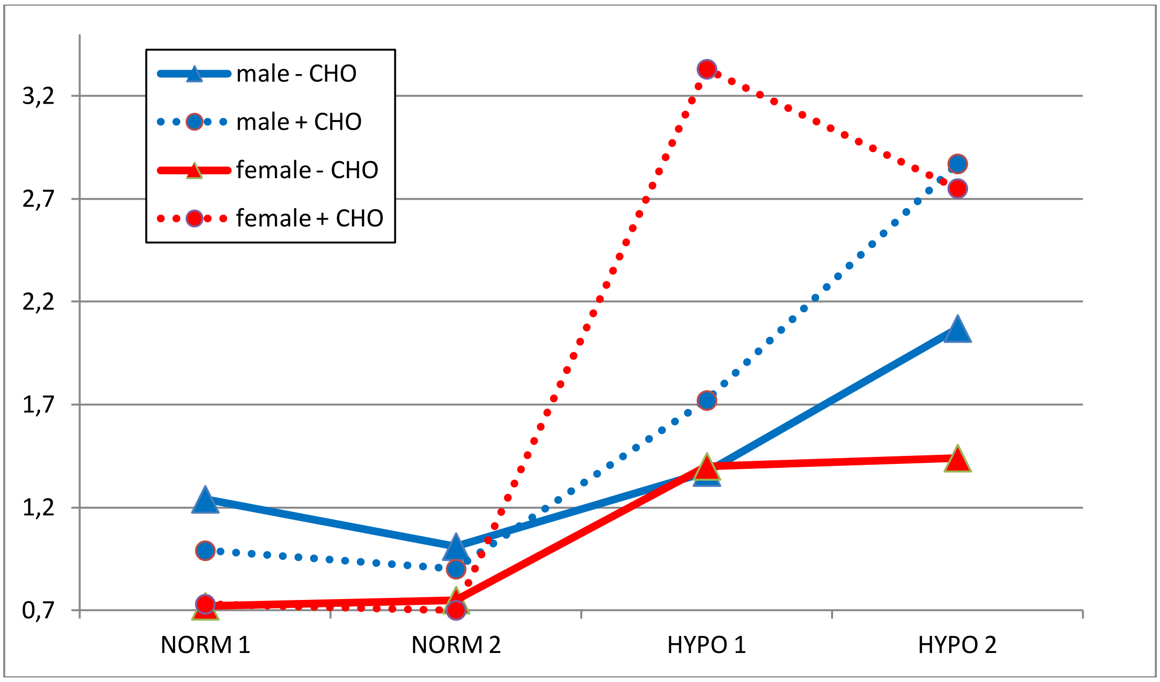

Fig. 3: LF/HF ratio in four phases of experiment

In females, the FD value significantly decreased, comparing both hypoxic periods with the second normoxia (NORM 1 vs. HYPO 2, $p=0.04$; NORM 2 vs. HYPO 2, $p=0.01$) (Fig. 4). The beta coefficient significantly increased comparing fasting normoxia to the second hypoxia (NORM 1 vs. HYPO 2 $p<0.05$).

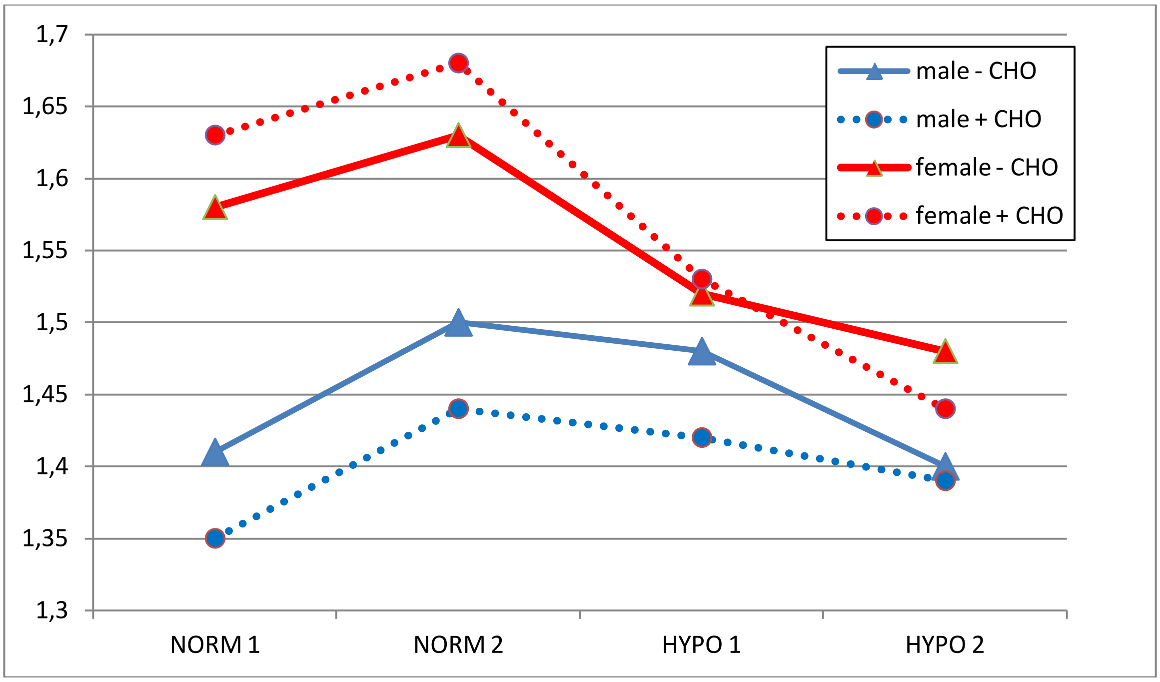

Fig. 4: Fractal dimension (FD) in four phases of experiment

Discussion

It is well known that the exposure to hypobaric hypoxia provokes a depression of autonomic functions and a shift in the sympatho-vagal balance towards more sympathetic and less parasympathetic activity [1-3]. Also the carbohydrate ingestion, but not fat or protein ingestion, increases sympathetic nerve activity [4-5]. To our knowledge, no other experimental reports have examined whether autonomic responses following carbohydrates ingestion are sex dependent. In fact, different authors considered the carbohydrates treatment only in women [7] or in men [8]. Our findings demonstrated differences in cardiac autonomic regulation comparing females to males after carbohydrate load and normobaric hypoxia. This study demonstrated in females but not in males a significant depressive effect of hypoxia and sucrose ingestion on the vagal function as well as a shift towards cardiac sympathetic excitation in these experimental conditions (Fig. 2 and Fig. 3).

On the other hand, the linear regression analysis between log(Power) and log(Frequency), performed by selecting the 0.004 Hz - 1 Hz band of the power spectrum, demonstrated a significantly different level of complexity of the system, as represented by the beta coefficient values, in males as well as in females, comparing normoxia with hypoxia after sucrose ingestion. Because the beta parameter is inversely related to complexity, a decrease of its value, as reported in our study, is indicative of less complex interactions of autonomic nervous control mechanisms over sinoatrial node, during acute exposure to hypoxia.

However, the FD, which represents another index able to assess the complexity of the signal rather the magnitude of the variability [11-12], confirmed only in female subjects a reduction of complexity as effect of hypoxia and carbohydrate load on cardiac ANS activity in comparison to normoxia.

Conclusion

This study suggests a different cardiac ANS modulation after carbohydrate ingestion and hypoxia comparing healthy young males to females. It is likely that women could present higher sensitivity to both these factors able by itself in particular conditions, to influence the sympathovagal balance.

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