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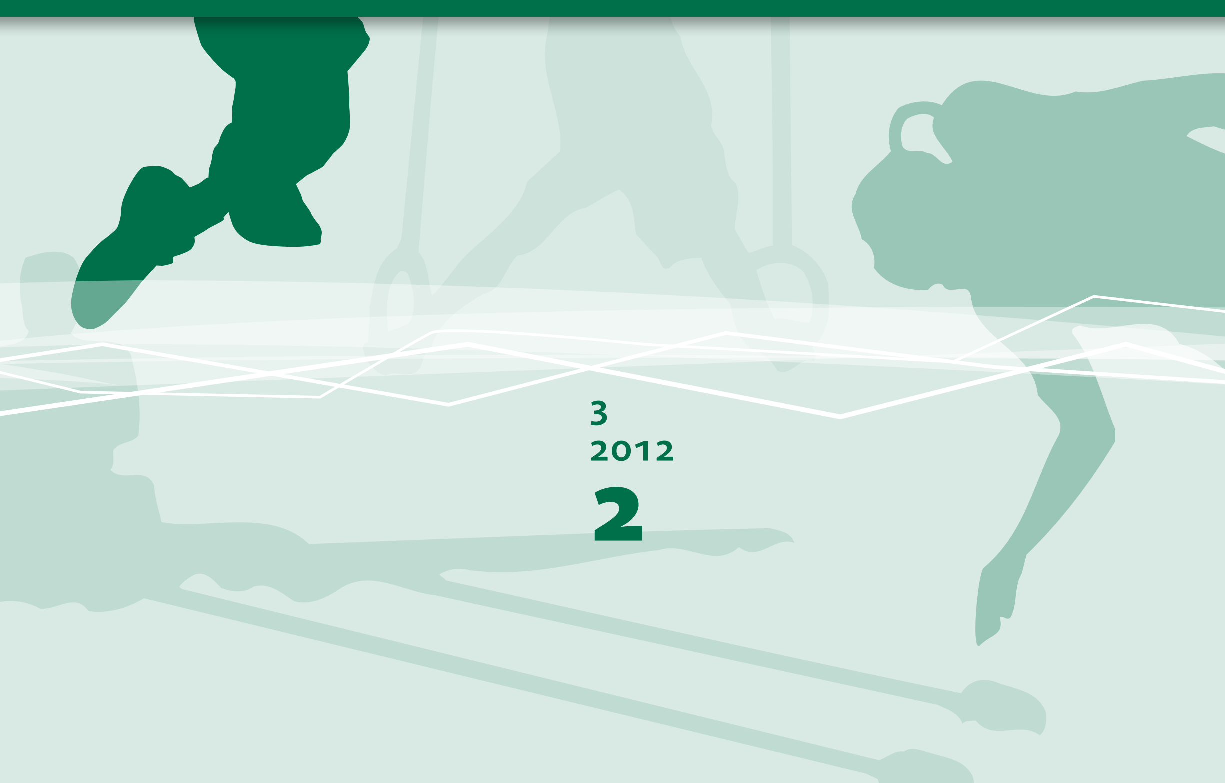

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EDITORIAL

Perhaps the power of arguments of kinesiology lies in its developmental aspect. To study and understand the meaning, which an appropriate quantity and quality of motor/sport activity presents to an individual through various periods of life as the lever of the quality of life, is the responsibility of a civilised society. It is our obligation to offer future generations new knowledge in the field of early developmental phase – when an individual establishes the conditions and acquire the fundamental motor competences, through the more active phase of an adult to the elderly, when the experience from previous years creates the destiny of the quality of living. In the rapidly ageing European society the concern for the elderly remains one of the necessary priorities, however, we are only scarcely aware of the role of childhood and youth as well as the way of spending an active adulthood in sustainable development. Therefore, the discussion on key factors that form a healthy lifestyle of modern generations in different periods of life is a very important challenge also in the field of kinesiology. In the year of intergenerational connection and active ageing and within the scope of kinesiology we wanted to make a contribution by studying this contemporary problem, and I believe that with the slogan "Child in Motion for Healthy Ageing" we managed to achieve our goal.

Critical thoughts based on contemporary research approaches present a new flow of information between theory and practice. And the present goal of kinesiology, an expressively integrative science, is therefore achieved!

Rado Pišot, PhD
(Editor in Chief)

UVODNIK

Morda je moč argumentov kineziologije največja ravno v njenem razvojnem vidiku. Preučiti in razumeti pomen, ki ga ustrezna količina in kakovost gibalne/športne dejavnosti predstavljata posamezniku skozi različna življenjska obdobja kot vzvod kakovosti življenja, je odgovornost civilizirane družbe. Prihajajočim generacijam smo dolžni ponuditi nova znanja tako zgodnjega razvojnega obdobja, ko posameznik šele vzpostavlja pogoje in usvaja temeljne gibalne kompetence, pa preko najbolj aktivnega obdobja odraslega do obdobja starostnika, ko nam renta predhodnih let kroji usodo kakovosti bivanja. V hitro starajoči se evropski družbi je skrb za starostnike ena izmed nujnih prioritet, vendar pa se redko zavemo vloge otroštva in mladostništva ter načina preživljanja aktivnega obdobja odraslega v trajnostnem razvoju. Ravno zato je obravnava ključnih dejavnikov, ki oblikujejo zdrav življenjski slog sodobnih generacij skozi različna življenjska obdobja, tudi na področju kineziološke stroke vedno večji izziv. V letu medgeneracijskega povezovanja in aktivnega staranja smo s preučevanjem te sodobne problematike želeli prispevati tudi v okviru kineziološke znanosti in verjamem, da nam je s sloganom »Otrok v gibanju za zdravo staranje« to tudi uspelo.

Kritične misli, temelječe na sodobnih raziskovalnih pristopih, predstavljajo nov pretok informacij med teorijo in prakso. In s tem je tokratni cilj kineziologije, izrazito integrativne znanosti, tudi dosežen!

dr. Rado Pišot
(glavni in odgovorni urednik)

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OBESITY AND METABOLIC SYNDROME IN CHILDREN AND YOUTH: A HEALTH RISK WE CANNOT AFFORD

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ABSTRACT

Ample observational and empirical evidence has been provided that indicates that childhood metabolic syndrome risk factors inevitably lead to significantly more profound health risk factors of developing potent adulthood metabolic syndrome. Much of these data has been provided from medical, nutritional, health, pediatric, physical education and associated communities. Perhaps the most visible and observable health risk factor among children (here referred to as youth) is the childhood obesity. Childhood obesity has reached epidemic proportions in western industrialized countries and is also becoming significantly more prevalent in Slovenia.

The youth inactivity is attributed directly to epidemic and perhaps exponential occurrence of obesity in pediatric and youth populations. The symptoms and signs of metabolic syndrome have previously been attributed mostly to the adult population; however, similar observations have been identified and observed in young and very young segment of population. The typical risk factors of metabolic syndrome in youth, in adolescents, and in adulthood have been commonly identified to be: stress, overweight and obesity, sedentary life cycle, aging, diabetes mellitus, coronary heart disease, lipodystrophy and several others.

This presentation will review and address several well known risk factors of developing metabolic syndrome in young years that directly contributes to adult obesity and are exhibited in significantly higher rates of hypertension, dyslipidemias, and insulin resistance, which are all risk factors for coronary heart disease, the leading cause of death in North America and may also apply to Slovenia. Many of these risk factors are modifiable (nutrition, smoking, sedentary life style, vigorous physical activity, reduction in TV and computer game times, etc.) with specific emphasis on very young, young, adolescents and profound consequences for adulthood. Several recommendations will be proposed that may contribute to reduction of health risk factors among youth. The *references have been generated from scientific literature and available information from various data bases in the United States, Center for Disease Control, National Institutes of Health, World Health Organization and several other relevant sources.*

These data and facts are very relevant to Slovenia because the inevitable truth is that these risk factors are "creeping up" into Slovenian society and it is my hope that you will be proactive and address these issues and act proactively rather than just stand by and observe the decline of health, especially among youth that will result in very costly financial burden of Slovenia for many years and decades to come.

Keywords: *metabolic syndrome, child obesity, nutrition, physical activity, child diabetes*

DEBELOST IN PRESNOVNI SINDROM PRI OTROCIH IN MLADINI: ZDRAVSTVENO TVEGANJE, KI SI GA NE MOREMO PRIVOŠČITI

IZVLEČEK

Številna opazovanja in znanstveni dokazi kažejo na to, da dejavniki tveganja za presnovni sindrom, ki so prisotni že v otroštvu, v dobi odraslosti neizogibno vodijo do bistveno bolj zaskrbljujočih tveganj za zdravje in povečajo možnost razvoja izrazitega presnovnega sindroma. Veliko teh podatkov je bilo pridobljenih v medicinski, prehranski, zdravstveni in pediatrični stroki ter od učiteljev telesne vzgoje in z njimi povezanih skupnosti. Najbolj opazen in izrazit dejavnik tveganja za zdravje med otroki in mladimi je morda prav debelost. Otroška debelost je v zahodnih industrijskih državah že dosegla razsežnosti epidemije, vse bolj razširjena pa postaja tudi v Sloveniji.

Neaktivnost mladih je moč neposredno povezati z epidemičnim in hitro rastočim pojavom debelosti pri otrocih in mladostnikih. Simptomi in znaki presnovnega sindroma so bili v preteklosti pretežno povezani predvsem z odraslo populacijo, vendar v zadnjem obdobju podobne ugotovitve opažajo tudi pri mladem in najmlajšem delu prebivalstva. Značilni dejavniki tveganja za presnovni sindrom pri otrocih, mladostnikih in odraslih ljudeh so pogosto opisani kot stres, prekomerna telesna teža in debelost, sedeč življenjski slog, staranje, sladkorna bolezen, bolezni srca in ožilja, lipodistrofija in številni drugi.

Pričujoči prispevek vsebuje pregled in obravnavo nekaterih znanih dejavnikov tveganja za razvoj presnovnega sindroma v mladosti, ki neposredno prispevajo k debelosti *pri odraslih in se kažejo v bistveno višjih stopnjah hipertenzije, dislipidemije in odpornosti na inzulin. Vsi našteti dejavniki pa so tudi dejavniki tveganja za bolezni srca in ožilja, ki so vodilni vzrok smrti tako v Severni Ameriki kot tudi v Sloveniji. Mnoge od teh dejavnikov tveganja lahko še posebej pri otrocih, najstnikih in mladostnikih spremenimo (nezdrava prehrana, kajenje, sedeč življenjski slog, povečana telesna dejavnost, skrajšanje časa, porabljenega za igranje računalniških igric in gledanje televizije ipd.), saj imajo globoke posledice v obdobju odraslosti. Predstavljenih bo več priporočil in napotkov, kako bi lahko prispevali k manjšemu tveganju za zdravje mladih. Predlogi so bili oblikovani na podlagi znanstvene literature in razpoložljivih informacij iz različnih baz podatkov Združenih držav Amerike, Centra za nadzor bolezni, državnih zdravstvenih inštitutov, Svetovne zdravstvene organizacije in številnih drugih preverjenih virov.*

Predstavljeni podatki so za Slovenijo zelo pomembni, saj je dejstvo, da se dejavniki tveganja vse hitreje »zajedajo« v slovensko družbo. V prispevku predstavljam svoje ugotovitve z namenom večjega ozaveščanja o omenjeni problematiki in posledično aktivnejšega pristopa k reševanju omenjenih težav, in ne zgolj opazovanja upada splošne ravni zdravja, zlasti med mladimi, kar se bo nenazadnje odražalo tudi v hudi obremenitvi slovenskega finančnega proračuna za več let in desetletij.

***Ključne besede**: presnovni sindrom, otroška debelost, prehrana, telesna dejavnost, otroška sladkorna bolezen*

INTRODUCTION

Despite very large magnitude of empirical data generated by the health professionals in various fields, equipped with documented evidence that adult obesity among western industrialized nations is on an exponential increase, yet, it appears that we are not taking this awesome health risks and financially very costly health problem seriously. Although, much of the focus has been devoted to adult population, the origins and early signs can be tracked back to childhood. Child obesity has been on an increase for quite some time and has reached epidemic proportions. This short review and overview is based predominantly on the U.S. population; however, since most of Europe often copy American products, commercialization, technology, science, medicine, education and other products including life style, it is only a matter of time when Slovenia and other European countries will also develop symptoms and signs of unhealthy, risky and detrimental forms of life styles and decline in personal wellbeing.

Table 1: Potential risks with obesity

Glucose intolerance	Menstrual abnormalities
Insulin resistance	Impaired balance
Type 2 Diabetes	Orthopedic problems
Hypertension (HBP)	Low self-esteem
High cholesterol	Negative body image
Sleep apnea	Depression
Asthma	Social stigma
Skin conditions	Discrimination
Teasing & Bullying	

According to the U. S. Center for Disease Control and Prevention, obesity has been termed national health epidemic in the United States. They state that 1 in 3 children and teens in U.S. are overweight or obese and that 1 in 3 young people born in the year 2000 will develop Type 2 diabetes. These may be the first time in the history of the U.S. that current generation of children may live shorter lives than their parents.

Many of the factors that contribute to childhood, adolescent, and adult obesity can be found in multitude of behavioral, environmental, genetic, socioeconomic, technological, commercial, industrial, financial, and other factors.

Table 2: The statistics

10% of children ages 2 - 5 years are obese
15% children ages 6 - 19 years are overweight
54% increase in obese < 13 year olds from 1980s - 1990s
In teens, 39% increase from 1980s to 1990s, with 64% increase in morbidly obese

Numerous national and international organizations, including the World Health Organization have declared obesity a global epidemic that if not controlled will garner major health risks not only in early years but also in adulthood and beyond. In the United States the occurrence of children and adolescence being overweight and obese has been estimated to exceed 15%. That value has tripled since in the past four decades as reported by the US National Health and Nutrition Examination Survey (www.cdc.gov/nchs/nhanes.htm). The consequences of overweight and poetical and ensuing consequence of obesity may result in numerous serious health risks for diabetes mellitus, atherosclerosis, hypertension, insulin resistance, coronary heart disease, orthopedic problems that may inevitably lead to consequences of metabolic syndrome.

Measurement and estimation of overweight and obesity

There are numerous ways to estimate and measure a person's body composition; meaning, general distribution of muscle, fat, and bone tissue. Some of the methods are quite cumbersome but also significantly more accurate as in dual energy x-ray absorptiometry or DXA, tomography, magnetic resonance imagery; however, these are quite expensive and not very well suited or available to most individuals who need to estimate the person's body composition that is associated with little or no cost to them or their organization. Some of the methods used that are simple, easy to apply and yet provide a good estimate of persons body composition including percent of total body fat. These methods may include but are not limited to skinfold calipers, underwater weighing or hydrostatic weighing, and circumference measures. Perhaps the simplest form of estimating overweight or obesity is the use of body mass index (BMI) that relies on person's weight and height. These are not very accurate measures and provide only an indirect assessment of body composition; however, when collecting large samples of a cohort of individuals, the results may be quite useful and may provide some indication of individual overweightness or obesity when compared to standards and tables for BMI. The Center for Disease Control and Prevention in the US has numerous charts available for children of various ages and sex, ranging from infancy to adulthood with various norms (www.cdc.gov/growthcharts). The importance of using these charts is to identify the population one wishes to study or examine and to apply the appropriate formulae that will most accurately estimate the desired result.

However, not all children increase their weight due to large food sizes or obsessive overeating. Some may have underlying medical condition or genetic predisposition that needs to be treated by a health provider via pharmacological agents and other medical or surgical interventions. Healthy nutrition and physical activity are two key factors in counteracting child and adolescent obesity. Unfortunately, the choices of food and drinks, much of television time, computer games, marketing and advertising of fast-foods during commercials in television, sedentary life style and lack of vigorous physical activity all contribute to the obesity epidemic.

Table 3: Factors which contribute to child's obesity

High-calorie foods/beverages are high in sugar.
Fast foods
Baked goods
Vending machine snacks
Soft drinks
Candy & desserts

Excess percentage of body weight due to accumulated body fat, body mass index (BMI) calculated from a child's weight and height, serious medical condition, and childhood obesity leads to health problems once limited to adults (diabetes, high blood pressure and high cholesterol). All these factors contribute to childhood obesity.

Table 4: Definition of obesity (children and adults)

Energy intake > energy expenditure
Body mass index (BMI) = weight (kg) / (height in meters)2
BMI 20-23 is ideal for teens / adults
120% or more of ideal body weight or BMI > 95% defined as obese
BMI > 30 = obesity in teens and adults
BMI > 95% = obesity in younger children

If the obesity is reduced by 10%, these will result in significant positive changes in Blood pressure by 10 mmHg (on the average), decrease in triglycerides below 100 mg.dl-1 or by 200 (if genetic defect present), increase in HDL-C by 3-5 mg.dl-1 and decrease on LDL-C via diet/weight loss combined can lower LDL by 25-30% if elevated.

Various organizations have used different criteria for determination of metabolic syndrome mostly in adult population. The World Health Organization (WHO), International Diabetic Federation (IDF) and Association and National Education Panel/ Adult Treatment Panel III (NCEP/ATP III), all subscribe to slightly different categories to rank or identify individuals who are termed to have metabolic syndrome. Although they differ to some degree in their criteria; however, they mostly agree that there is a serious problem with metabolic syndrome and obesity in industrialized countries. The WHO require impaired glucose response and two other criteria, namely, the presence of microalbuminuria calculated as albumen/ creatinine ratio >30 mg.gm-1 creatinine. The IDF require central obesity plus two of the other abnormalities and the NCEP/ATP III require three or more of the five criteria for adults, namely, resistance to insulin-stimulated glucose uptake, Hyperinsulinemia, hypertension, glucose intolerance, increased VLDL-C triglyceride, and decreased HDL-C cholesterol.

The American Medical Association (AMA) requires three or more of the following criteria to designate a person as having metabolic syndrome as an adult. These categories are obesity (BMI >95th %), elevated blood pressure (systolic and/or diastolic >90th %), abnormal blood lipids (HDL-C< 40 mg.dl-1, and/or triglycerides >150mg. dl-1), impaired glucose tolerance (fasting glucose >100 mg.dl-1, 2h glucose >140, or any glucose >200 mg.dl-1).

Perhaps the most serious consequence of children and adolescence being overweight or obese is their predisposition to serious consequences for cardiovascular disease (CVD), coronary heart disease (CHD), heart failure (HF), cardiomyopathies, dyslipidemias and various other metabolic and cardiovascular diseases.

Heart disease is the major cause of mortality in industrialized countries. Despite reduction in mortality rates from heart disease over the past two decades, the CVD, CHD and HF continues to be the leading cause of death and public health problem. Heart disease is and continues to be responsible for more than 30% of all deaths, with ischemic heart disease representing 65% of this total. With improved mortality rates of coronary artery disease (CAD) has come greater understanding of how atherosclerosis arises and may be prevented. Assessment of the early onset of CVD in childhood is important to determine optimum preventive measures. Understanding of the early development of adult heart disease may help prevent or at least reduce cardiovascular heart disease since both the overweight and obesity in childhood and adolescence are frequent instigators of adult onset of metabolic syndrome and subsequently also responsible for heart disease.

The manifestation of metabolic syndrome according to almost all national and international organizations (WHO, IDF, NCEP/ATP III) identify excessive amount of lipids and lipoproteins (except HDL-C) as major risk factor as well as developing cardiovascular disease. When addressing the above normal values of lipids and lipoproteins in children, adolescents, or in adulthood, one cannot ignore the formation and development of atherosclerosis and tracking of lipids and lipoproteins from childhood into adulthood. There are a number of physiologic and pathologic events that underline the onset of CVD. The two major culprits in the process of developing cardiovascular disease are poor nutrition and sedentary life style or physical inactivity.

Since today's youth consume rather large quantities of fast foods, soda drinks, saturated fats and cholesterol rich meals, and therefore, it is not surprising that children and adolescents show elevated lipid levels and formation of atherosclerotic lesions. Although, all blood lipids and lipoproteins are important when assessing one's health, much attention has been focused on two main lipoproteins, namely, high-density lipoprotein cholesterol (HDL-C) and low-density lipoprotein cholesterol (LDL-C). Most studies investigating coronary heart disease relate elevated LDL-C and low levels of HDL-C. Many of these studies have demonstrated that adverse levels of CVD risk factors can be identified in childhood, although CHD do not usually occur until middle age.

Nicklas, von Duvillard and Berenson (2002) who tracked lipids and lipoproteins from childhood to dyslipidemias in adults as part of the Bogalusa Heart Study reported that lipids and lipoproteins measured in childhood were amplified profoundly also in the adulthood. They also reported that the percent of adult abnormality in obesity was significantly greater in participants who were at high childhood risk (39%) compared to children who were at acceptable risk for (24%) even after correcting for age. Participants in this study who were classified at high risk in childhood also had a significantly higher prevalence of hypertension (16%) compared to participants with low childhood risk (7%). Their data demonstrate that serum lipid and lipoprotein levels continue to track from childhood into young adulthood. The persistence of multiple CVD risk factors from childhood to adulthood and the impact of obesity in this regard point to the need for preventive measures aimed at developing healthy life style early in life.

As mentioned before, diabetes is an extremely potent risk factor for atherosclerosis. This increased risk is mediated through multiple mechanisms that include chemical modifications of the LDL particles (glycation) that makes these particles even more atherogenic. Similarly, hypertension that often accompanies obesity has created a secondary epidemic of insulin resistance and type 2 diabetes among children throughout the industrial western world.

Physical activity

Sedentary life style and profound decline in exercise have been linked repeatedly with multiple adverse health risks in both men and women. Belay, Belamarich and Racine (2004) reported that 50% of youth ages 12 to 21 years do not engage in regular vigorous exercise. They also found that American children who spend significant amount of time watching television is strongly linked to the risk of future obesity. Recommendation of the Center for Disease Control and Prevention (CDC) strongly suggest that both male and females benefit from physical activity. Furthermore they suggest the following:

- Physical activity need to be strenuous to be beneficial
- Moderate amount of daily physical activity are recommended for people of all ages. This amount can be obtained in longer sessions of moderately intense activities, such as brisk walking for 30 minutes, or shorter sessions of more intense activities, such as jogging or playing basketball for 15 to 20 minutes.
- Greater amounts of physical activity area even more beneficial, up to a point. Although excessive amounts of physical activity can lead to injuries, menstrual abnormalities, and bone weakening.

What can we do to help our children to be better citizens, to achieve maximal potential, prevent or reduce potential medical hazards and to reach respectable longevity? Here are some suggestions:

- Focus on strategies that increase physical activity, healthy eating and weight control behaviors, sources of social support, and issues of weight-related stigmatization and self-esteem
- Build exercise into family life/activities
- Help families make a few small, permanent changes at a time
- Set TV and videogame limits - and take out of the bedroom
- House Rules: no food in front of the TV/computer
- Change family patterns to incorporate exercise - bowling on Friday night instead of popcorn and a movie
- Family dinners!

It all starts with you, your schools, town or city, your community and your political leaders, etc. Do not take health for granted and help our children to become more active, not just once but every day, stay engaged in their life while they are still children and adolescence because before you know it they will become young adults and establish their own families; however, if you planted the seed of healthy nutrition, active and vigorous activity, prevent smoking and other hazardous activities that too will pass those values to their children and you can and should be very proud of what you were able to achieve.

CONCLUSION

The occurrence and prevalence of childhood obesity and thus predisposition to metabolic syndrome has reached epidemic proportions. Medical professions and pharmaceutical industry alone cannot solve this health problem. The society, parents, schools, teachers, community leaders, state and federal government, and others will need to take significantly more active role in promoting appropriate and responsible nutrition and caloric intake and very proactively support and increase energy expenditure that should be strongly supported and implemented in all aspects of societal life. Advances in technology, social media, schools, academics, and other aspects of society should strongly encourage and promote physical activity, exercise, responsible and quality nutrition, changing attitudes about food choices, portion size and create environmental factors such as bike paths, green environments, walking and jogging opportunities, physical education and various other family activities that promote health and wellbeing. These are not only responsibility of community but they start with each individual, responsible parents, school board members, community leaders, state and federal government. This is not an easy task; however, we need to work together to reduce if not solve this epidemic obesity and metabolic syndrome of our children and youth.

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QUANTIFYING LIFE STYLE IMPACT ON LIFESPAN

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ABSTRACT

A healthy diet, physical activity and avoiding dangerous habits such as smoking are effective ways of increasing health and lifespan. Although a significant portion of the world's population still suffers from malnutrition, especially children, the most common causes of death in the world today are non-communicable diseases. Overweight and obesity significantly increase the relative risk for the most relevant non communicable diseases: cardiovascular disease, type II diabetes and some cancers. Childhood overweight also seems to increase the likelihood of disease in adulthood through epigenetic mechanisms. This worrisome trend now termed "globesity" will deeply impact society unless preventive strategies are put into effect. Researchers of the basic biology of aging have clearly established that animals with short lifespans live longer when their diet is calorie restricted. Although similar experiments carried on rhesus monkeys, a longer-lived species more closely related to humans, yielded mixed results, overall the available scientific data suggest that keeping the body mass index in the "normal" range will increases the chances of living a longer and healthier life. This can be successfully achieved both by maintaining a healthy diet and by engaging in physical activity. In this review we will try to quantify the relative impact of life style choices on lifespan.

Keywords: *lifestyle, physical activity, child, obesity*

KVANTITATIVNI UČINEK ŽIVLJENJSKEGA SLOGA NA TRAJANJE ŽIVLJENJSKE DOBE

IZVLEČEK

Zdrava prehrana, telesna dejavnost in izogibanje nevarnim navadam, kot je kajenje, so učinkoviti načini za podaljšanje dobe zdravja. Čeprav občutni del svetovne *populacije, ki vključuje predvsem otroke, še vedno trpi zaradi podhranjenosti, pa večina svetovnega prebivalstva danes umira zaradi nenalezljivih bolezni. Prekomerna telesna teža in debelost sta dejavnika, ki znatno povečata relativno tveganje za najbolj izrazite nenalezljive bolezni: bolezni srca in ožilja, sladkorna bolezen tipa II in nekatere vrste raka. Raziskave kažejo, da prekomerna teža v otroštvu dodatno poveča verjetnost za bolezni v poznejši odraslosti, tudi preko epigenetskih mehanizmov. Ta zaskrbljujoč trend, ki ga mnogi opisujejo z besedo "globesity", bo v bodoče globoko vplival na družbo, če ne bomo razvili in uresničili preventivnih strategij. Raziskovalci osnovne biologije staranja s pomočjo preizkusov na živalih s kratko življenjsko dobo jasno ugotavljajo, da prehrana z omejenimi kalorijskimi vrednostmi prinaša daljšo življenjsko dobo. Čeprav je podoben preizkus, opravljen na opicah rhesus, ki so živali z zelo dolgo življenjsko dobo in zato tesneje povezane s človeško vrsto, prinesel mešane rezultate, so razpoložljivi znanstveni podatki pokazali, da je potrebno indeks telesne mase ohraniti v mejah »normalnih« vrednosti, da bi povečali možnosti za daljšo zdravo življenjsko dobo. To je mogoče uspešno doseči z zdravo prehrano in s telesno dejavnostjo. V sledeči analizi bomo poskušali oceniti relativne vplive izbire življenjskega sloga na dolžino zdrave življenjske dobe.*

Ključne besede: *življenski slog, fizična aktivnost, otroci, debelost*

INTRODUCTION

In biomedical sciences it is usually said that phenotype is the result of the interaction between *genotype* and *environment.* There is a vigorous debate regarding which of the two has the largest influence, but often the dispute is solved by saying that each counts for 50% of the total. For the present discussion on longevity, a different division of factors able to influence phenotype and consequently, in the long run, our lifespan is proposed: *genes*, *chance* and *life style choices*.

INFLUENCE OF GENES

Explaining the roles of genes on lifespan is relatively easy when one makes the following consideration. In contrast to automobiles or other objects that may be built using different quality materials and may consequently last for longer or shorter periods of time, all the different species are made by the same biochemical building blocks: nucleotides, amino acids, fatty acids, carbohydrates etc. In spite of the same “material” employed by nature, maximum longevity is very different among different species: 4

years for a mouse, 122 years for humans and 210 for the bowhead whale (Carey, 2000) [for more animal data see also the extensive collection of species longevity records available online at The Max Planck Institute for Demographic Research].

These enormous differences are probably to be ascribed to a higher capacity in the cells of long-lived species to detect and repair molecular damage [for example see (Lorenzini et al., 2009; Fink, Roell et al., 2011)]. The more accepted evolutionary theory of aging proposes that these cellular repair mechanisms have been positively selected by evolution in species living in biological niches with relatively low mortality rates [for a more clear description of the evolution of longevity, see (Austad, 1997)].

Genetic differences are of course what makes one species different from another. These also account for human variations in eye colour, height, nose shape and, of course, also longevity. Statistical variance measures the average of the squared distance between each of a set of data points and their mean value. Ljungquist and colleagues, in their interesting analysis of identical and fraternal Swedish twins in our species, have concluded that a maximum of around one third of the variance in longevity is attributable to genetic factors (Ljungquist, Berg, Lanke, McClearn & Pedersen, 1998).

INFLUENCE OF CHANCE

The role of chance on longevity is obvious if we consider that all sorts of accidents may shorten our life span or even abruptly end it. Of course, an unfortunate encounter with a microscopic pathogen such as a virus or a bacterium may also shorten our lifespan. It is obvious that these and many other risks have the capacity to influence the length of our lives, but it also seems obvious that they belong to the category of environmental risks, making the proposed division into three categories (genes, chance and choices) appear redundant. Why should we not unite *chance* and *life style choices* in one unifying category called *environmental influence*? There is strong evidence that chance at the molecular and cellular levels is intimately connected to life and independent of the environment, at least relatively to our capacity to control it. To explain this concept with examples let's think of the lifespans of identical twins. Identical twins may get different diseases or the same disease at different ages (Cook, Schnek & Clark, 1981), and of course they may eventually die at different ages (Ljungquist et al., 1998); they have the same genes, but of course we cannot assume that they live in identical environments: even small differences in food choices, for example, could have a potentially important influence on life span. It is different if we move from humans to rodents. In biomedical science the so called "inbred" strains are very useful research models. These are colonies of mice obtained by crossing brothers and sisters for many generations (usually more than ten) so as to obtain, eventually, a colony of genetically identical rodents. The facilities where these laboratory animals are typically housed probably represent the places where man has reached the highest control of environmental conditions. For their entire lives, these animals are housed in identical cages at a constant temperature with a cycle of 12 hours of light and 12 hours of darkness, and they eat that same food with all the needed micronutrients. Although their genes are identical and their environment virtually constant, their lifespans still vary dramatically. For example, the first mouse in a colony may die after only 200 days of life, while the last mouse of the same colony may live well beyond 800 days (see for example the survival curve for the YBR/EiJ inbred strain on the web site of the Jackson laboratory, a research organization that also supplies biomedical scientists with animal models). This intrinsic biological aspect of chance is rarely mentioned in the biomedical literature, although two well know gerontologists have dedicated an entire monograph to this subject (Finch, 2000).

INFLUENCE OF LIFE STYLE CHOICES ON LIFESPAN

The dependence of lifespan on lifestyle choices is of course what attracts our attention the most. We cannot choose our parents, and consequently we cannot choose our genes. We cannot, by definition, influence our luck or lack of it; even less are we able to influence the chaotic and random components of the lives of our cells and molecules. But in spite of this, it is still important to make wise lifestyle choices since it seems clear that a significant fraction of our lifespan may depend on them. We will dedicate the rest of this essay to this topic.

LIFE STYLE CHOICES

We can divide lifestyle choices into three general categories: keeping away from danger (or not), choosing healthy food (or not), and being physically active (or not). An easy example of "keeping away from danger" is deciding not to smoke. Of course, a lung cell beginning to divide uncontrollably and eventually ending up in a malignant cancer is a random event, but we may lower the likelihood of this event (or not) by simply choosing to smoke (or not). Jeanne Calment of France has so far been the longest-living person on record. She quit smoking at age 119 because she was too blind to light up a cigarette herself, and too proud to ask someone to do it for her. She eventually died at age 122. What can we say with certainty about her long lifespan? That besides probably having very good longevity genes she was also simply lucky! What to eat and how physically active to be are choices that we have to make every day, and they can have a significant impact on our healthspan and lifespan. During a recent survey conducted at an elementary school in a village near the city of Bologna, Italy, we saw first-hand the direction the Western world has taken in terms of lifestyle (Tiso et al., 2010). Children in the West consume too few fruits and vegetables, and too many of them are not physically active enough. The danger in this aspect of our societies goes beyond the well-studied psychological conditioning that impacts adult lifestyle choices. In other words, children who are not educated to be active while growing up will probably have higher chances to become sedentary adults later on in life, but this is not all. At a subtle biological level, in fact, this will predispose their bodies to adult obesity and other negative conditions. When obesity is reached during a child's development, it influences the development of the adipose tissue so that when adulthood is reached, the body has a higher number of adipocytes compared to that of an adult whose weight during childhood had been normal (Oscai, Babirak, Dubach, McGarr & Spirakis, 1974; Spalding et al., 2008). The body of an adult with more adipocytes stores fat more efficiently. For this adult, consequently, it will be more difficult to maintain normal weight in our "obesogenic" environment where foods rich in sugar and fat are almost always readily available.

These negative effects of unhealthy lifestyle choices are particularly relevant in the early phase of development where they seem capable of influencing even appetite (Rajia, Chen & Morris, 2010). As stated above, these biological conditions are independent of the better-known psychological conditions. The negative effects of both are cumulative.

CALORIC RESTRICTION AND LONGEVITY

The first official report describing the effects on lifespan of a drastic reduction in calories consumed dates back to 1935. In this seminal report, McCay et al. demonstrated that rats kept at near-starvation would have extended longevity (McCay, Crowell & Maynard, 1935). The restriction in calories is considered by the vast majority of gerontologists to be the most robust non-genetic approach to enhancing healthspan and extending lifespan in many species of animals. So far, biologists have used this approach to extend the lifespan of yeasts, worms, spiders, water fleas, rotifers, fish, birds, dogs and even cows (Pinney, Stephens & Pope, 1972). Although these studies are well known among the scientific community, the general public usually has never heard about the influence of caloric restriction on healthspan and longevity. There are people trying caloric restriction (CR) on themselves, and some have created associations like CR Society International and online groups to share recipes and discuss recent advances in the science of aging and longevity. The key and as yet unanswered question is whether CR will work in humans, and if so, to what extent. In rodents, a 40% reduction in food intake can increase median and maximum lifespan by up to 50%. Could CR have similar an effect in humans? Will CR work even if started only after adulthood is reached? At middle age? These are the most common and relevant questions.

Let see what the science of aging has been able to answer so far. In rodents (the most tested species are mice and rats) the most impressive results are obtained when CR is started during development, but it will work even if stared later on in adulthood, although proportionally, giving an increasingly minor lifespan benefit the later it is started. But what is the amount of restriction we should endure and what is the amount of life extension we could reasonably expect as humans?

Phelan and Rose propose that the increase in longevity that primates, and therefore also humans, may expect is much less significant than that observed in rodents (Phelan & Rose, 2005). Their prediction states that at best humans will experience a 7% increase in lifespan. Their theory is based on an evaluation of how many energy resources are dedicated by a species to reproduction. At least for gestation and lactation, rodents seem to invest much more energy resources than primates. Consequently, Phelan and Rose (2005) speculate that the metabolic switch that CR is able to trigger diverts much of the energy from the metabolic activities related to reproduction to soma maintenance mechanisms, making these mechanisms more efficient in preserving health and consequently prolonging lifespan significantly. Two major on-going studies are currently being conducted on a long-lived primate, the rhesus monkey. Although many of the monkeys are still alive, the researchers have already published the most probable end results of their studies. In one study, the authors concluded that a 30% CR is able to significantly reduce the age at which animals experience their first age-associated diseases (Colman et al., 2009), but in the other the conclusion is that a similar reduction does not influence healthspan and lifespan significantly (Mattison et al., 2012). Although several interesting considerations can be made about these two studies, which have not used the same design, [for a detailed comparison see an interesting commentary (Austad, 2012)] here we will simply say that the available primates data seems so far to support Phelan and Rose predictions of a limited impact of CR on human longevity. Does this mean that the quantity of food we eat is not an important variable in determining our healthspan? Absoluttely not. It is safe to say that overall the CR data underline the importance of retaining as long as possible a "normal" adult weight. It is well known that body weight tends to increase with age. This is true not only for humans, but also for animals kept in a zoo or a laboratory. CR could exert its effect on longevity by simply preventing overweight and obesity.

QUANTIFYING THE EFFECT OF LIFE STYLE CHOICES ON LONGEVITY

We said above that lifespan is definitely influenced by our genes, but of course we cannot choose our mother and father and consequently we have to keep the genes we have. We also said that random chaotic molecular and cellular events may shorten or prolong our life span completely independently of our genes and of our lifestyle choices. Why, then, should we worry about the influence of our lifestyle choices on our healthspan? How much room is left? How much can our choices actually affect the length of our lives?

A very elegant study sought to answer exactly these questions (Khaw, Wareham, Bingman, Welch, Luben & Day, 2008). Khaw and colleagues followed 20,244 men and women aged between 45 and 79 years, for an average of 11 years. These scientists then divided the population following a simple design in which they assigned1 point to non-smoking subjects, 1 point to subjects eating 5 or more portions of fruits and vegetables daily, 1 point to subjects who engaged in moderate consumption of alcoholic beverages, 1 point to subjects who undertook at least half an hour of leisure-time physical activity a day or who had jobs requiring physical activity.

The survival rate of this cohort was then observed after dividing the population into groups composed of people receiving 0, or 1, or 2, or, at best, 4 points. People receiving 4 points were, of course, considered the ones making the best life style choices.

The result of this analysis was a survival difference between the “0 point-ers” and the “4 point-ers” of 14 years.

This very interesting analysis considers the lifespan impact of several lifestyle choices: good nutritional habits (lots of fruit and vegetables and not too much alcohol), being physically active, and avoiding at least one dangerous behaviour (smoking), but it does not take into account the nutritional parameter of caloric intake, the importance of which we already underlined when we talked about caloric restriction. To quantify the impact of caloric intake, let us consider the result of a very large meta-analysis in which data was collected from 57 different studies with an impressive total of 900,000 subjects (Whitlock et al., 2009). The authors estimated the lost years due to excess body weight by comparing the average lifespans of obese people (body mass index between 30-35) to that of normal-weight subjects (BMI between 22.5-25). The results are about 3 years for obese women and 4 years for obese men. This estimate was made for people over 35 year of age who reached obesity at around 60 years of age, although similar results were obtained by an analysis of United States lifespan tables that included data from age 20 and up, and all the body mass index categories (Fontaine, Redden, Wang, Westfall & Allison, 2003). Avoiding obesity, therefore, adds 3 or 4 years to the years already gained by making the four previously mentioned healthy life style choices.

CONCLUSION

In conclusion, we will calculate whether it is reasonable to invest in “healthy lifestyle choices” as early as possible in life, as well as whether it makes sense to make these choices for our children and to educate them in “healthy nutrition” and “healthy physical activity”.

The data from the studies cited in the previous paragraph suggest that people eating a lot of fruits and vegetables, keeping physically active, and avoiding smoking, obesity and excess alcohol, gained 17-18 extra years of life on average.

The cohorts analysed in these studies included mostly people from Western Europe and North America, born just before the end of the first half of the previous century. Considering that life expectancy at birth in 1950 was 68.2 years in the United States (Grove, 1968) we may reasonably say that good lifestyle choices may account for at least one fourth of the duration of our lives.

The present average life expectancy in the Western world is around 80 years (see the WHO Global Health Observatory online charts), and life expectancy has increased linearly in the last century (Oeppen & Vaupel, 2002) and will probably continue increasing; consequently, one fourth of the average lifespan means 20 years for today's children and will mean even more years for the children of tomorrow. These considerations alone provide sufficient justification for "healthy lifestyle" choices. If to the arguments presented in this paper we were to add a discussion of the "quality of life" and how significantly this can be improved by making healthy lifestyle choices, it would be clear just how easy the decision between healthy living and its opposite, the "enjoy today, don't worry about tomorrow" lifestyle, really is.

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DOES PHYSICAL ACTIVITY AT A YOUNG AGE REALLY MEAN A HEALTHIER ADULTHOOD AND OLD AGE?

Analysis

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ABSTRACT

Physical education in schools endeavours to develop life patterns through encouraging regular physical activity and sports in childhood and youth, so as to establish a life-long goal that will reflect in an active, healthy lifestyle and consequently in a higher quality of life also in adulthood and old age. This, however, also raises an important question: Are these goals in fact achieved?

The purpose of this paper is based on a review of available, particularly longitudinal, studies and aims at determining the extent of the impact of an active lifestyle and an appropriate level of physical fitness in youth on the health, physical activity and lifestyle in later stages of life.

Despite the great interest in academic research of the issue, this question has not yet obtained a completely clear answer. The overall conclusion of most significant longitudinal studies around the world is that a physically active lifestyle developed during childhood and adolescence generally transfers to adulthood; however, the links between practising sports / doing physical activity during childhood/adolescence and adulthood are low (r = 0.09 to 0.25). The relationship between the individual stages of life decreases with an increase of the age interval under observation. On the other hand, more advanced training programmes for young people have a greater impact on the physical activity and health status of the same people in later periods of life.

Many more extensive longitudinal studies will be required in order to clarify this issue. Nevertheless, a basic finding is clear: only regular and systematic physical activity both in youth and later periods can contribute to better fitness and better health.

Keywords: *physical activity, health, lifestyle, youth, adulthood*

ALI TELESNA AKTIVNOST V MLADOSTI RES POMENI BOLJ ZDRAVO ODRASLOST IN STAROST?

Analiza

POVZETEK

Med najpomembnejšimi cilji športne vzgoje je z redno telesno in športno dejavnostjo razviti take vzorce življenja otrok in mladine, da bodo dejavnost in kakovost življenja ter zdrav življenjski slog njihovo vodilo tudi v odraslosti in starosti. Ob tem pa se postavlja pomembno vprašanje: Ali te cilje v resnici tudi dosegamo?

Namen prispevka je na osnovi pregleda dostopnih opravljenih, zlasti longitudinalnih, študij ugotoviti, kakšen vpliv imata aktiven življenjski slog in ustrezna raven telesne pripravljenosti mladih na zdravje, telesno aktivnost in življenjski slog v kasnejših obdobjih življenja.

Kljub velikemu znanstvenemu interesu za proučevanje te problematike danes na to vprašanje še nimamo povsem jasnega odgovora. Splošna ugotovitev najpomembnejših longitudinalnih študij v svetu je, da se športno aktiven življenjski slog, razvit v otroštvu in mladostništvu, prenaša v odraslost, vendar so povezave med športno/telesno aktivnostjo v otroštvu/adolescenci in odraslem obdobju nizke (r = 0,09–0,25). Povezanost med posameznimi starostnimi obdobji se manjša s povečevanjem opazovanega starostnega intervala. Zahtevnejši vadbeni programi mladih pa imajo večji vpliv na telesno aktivnost in zdravje v kasnejših obdobjih življenja.

Za razjasnitev tega problema bo potrebno še več obsežnih longitudinalnih študij, a osnovno spoznanje je jasno: le redna in sistematična telesna aktivnost tako v mladosti kot kasnejših obdobjih lahko pripomore k boljši telesni pripravljenosti in boljšemu zdravju.

Ključne besede: *telesna aktivnost, zdravje, življenjski slog, mladostniki, odrasli*

INTRODUCTION

Physical activity holds an irreplaceable role in a person's lifecycle. It is an essential factor, essential for a normal biological, social and mental development and for the general health of young people; in mature years and old age, regular and suitably chosen physical activity or exercise preserves a person's vitality, it protects him/her against diseases and contributes to a higher quality of life.

Following the recommendations of the World Health Organization (WHO) (Roberts, Tynjala & Komkov, 2004) and the British Institute for Health Education - UKHEA (Biddle, Sallis & Cavill, 1998), young people should practise moderate to intense physical activity for at least 60 minutes per day.

The WHO report of 2004 (Young people's health in context – Health Behaviour in School-eged Children (HBSC) study: International report from the 2001/2002 survey; Mulvihill, Nemeth & Vereecken, 2004) shows that the recommended extent of physical activity is only obtained by one in every two 11-year-old boys, 41% of 13- year-old boys and only 33% of 15-year-old boys; with girls, these numbers amount to one in three 11-year-olds, one in four 13-year-olds and one in five 15-year-old girls. Their physical activity of girls decreases by about 50% between the ages of nine and fifteen. The situation only worsens in high school. Only 15% of girls remain adequately physically active.

Considering such data, it is not surprising that young people today are physically less able compared with young people just some decades ago – their level of fitness is generally worse. For instance, the results obtained in aerobic capacity tests (or more precisely, the results from a 600m running competition) undertaken by children and youth in Slovenia since 1990, have been continuously falling by 0.56% each year (Strel, Kovač, Jurak, Starc, Bučar-Pajek & Leskošek, 2007).

The significance of physical activity and corresponding physical fitness in children and young people would undoubtedly be lower if poor fitness and its common side-effect of an unhealthy body-mass index didn't lead to medical conditions and shorter lives. A combination of inactivity, an unhealthy diet and low physical capacity of children and youth leads to an unhealthy life and illness. Factors of metabolic syndrome (MS) and of cardio-vascular diseases, diabetes, etc. have already become pediatric problems. Children who are not sufficiently physically active already have a much greater chance of encountering problems with their cardiovascular condition in their teens (Eriksson, Taimela & Koivisto, 1997; Erikseen, 2001; McMurray, Bangdiwala, Harrell & Amorim, 2008). Already in childhood, a large amount of subcutaneous fat and poorer physical ability are associated with higher blood pressure, insulin resistance, poor blood lipid profile, poor left ventricular geometry and poor pumping function of the left ventricle (Thomas, Baker & Davies, 2003; Vaccaro & Mahon, 1989). Many researchers have reported that at least one MS factor is present in more than half of the children in the developed world (McGill, McMahan, Herderick, Malcom, Tracy & Strong, 2000; Huang, Ball & Franks, 2007).

The most important lever for the promotion of physical activity is physical education (PE). Therefore, PE plays a very important role also in terms of public health (Salis & McKenzie, 1991; Haywood, 1991; Pate, Corbin, Simons-Morton & Ross, 1987). One of the primary goals of physical education in schools is to develop life patterns in youngsters and children through encouraging regular physical activity and sports at an early age, so as to form life-long habits that will reflect in an active, healthy lifestyle and consequently in a higher quality of life also in adulthood and old age.

PURPOSE OF THE PAPER

In terms of assessment and evaluation of the effectiveness of physical education in achieving this objective, the following logical question is raised: do an active lifestyle and an appropriate level of fitness in young people have an impact on their health, physical activity and lifestyle in later periods?

This question has not yet been clearly and directly answered to this day. The only empirical evidence obtained so far consists in the following two facts:

a) Physical activity and physical ability in young people are associated with different parameters of their health condition (Terry Huang, Ball & Franks, 2007; Eriksson, Taima & Koivisto, 1997; Rizzo, Ruiz, Hurtig-Wennlöf, Ortega & Sjöström, 2007, Fox, 2004; Van Veldhoven et al., 2001, Welsh, Kemp & Roberts, 2005, Houston et al., 2002);

b) Physical activity and physical ability in adults are linked to their health condition (McMurray, Harrell & Amorim, 2008; Souza, Cardoso, Yasbek & Faintuch, 2004; Boreham & Riddoch, 2001).

Therefore, the purpose of this paper is to determine whether physical activity of children and young people has a direct impact on their physical activity and physical fitness and health in later periods of life and how strong this impact is, based on the analysis of the results of the available studies.

METHODOLOGICAL APPROACH

We tried to obtain an answer to this question on the basis of the following analyses of the results of academic research:

- analysis of the results of studies on the transmission of various health risk factors from childhood/adolescence to adulthood
- analysis of the effects of physical activity in childhood/adolescence on the lifestyle and health in adulthood,
- analysis of the impact of various programmes, content and complexity of physical activity in youth on the lifestyle and health in adulthood,
- analysis of the effects of hereditary and environmental influences on the lifestyle and health in adulthood.

Over 130 academic papers were collected for the purpose of the study. The analyses are based on longitudinal studies that have been conducted over the past two decades. We mainly selected large national longitudinal studies that were published in high profile and influential scientific journals.

PRESENTATION OF THE STUDIES AND THEIR FINDINGS

Analysis of the results of studies on the transmission of various health risk factors from childhood/adolescence to adulthood

Metabolic syndrome and related diseases. MS involves different risk factors for the development of many chronic diseases such as cardiovascular diseases (CVD), type 2 diabetes, liver or kidney conditions and certain cancers (Terry, Huang, Ball & Franks, 2007; Bitsori & Kafatos, 2005; Grundy, 2005). In medicine, MS is defined by the presence of three or more of these risk factors (Terry Huang, Ball & Franks, 2007). Individual factors are tightly related to each other and have a strong synergistic effect.

Individual MS factors differ in their natures during various periods of human life. Results of European and Canadian longitudinal studies (Andersen, Hasselstrom, Gronfeldt, Hansen & Karsten, 2004; Katzmarkzy, Perusse, Malina, Bergeron, Despres & Bouchard, 2001) indicate that the relationship between the presences of individual MS factors through different time periods is medium (r = 0.40 to 0.60). Most pronounced is the transfer of problems with excessive body weight, the amount of adipose tissue (r = 0.70), hypertension (r = 0.40-0.54) and reduced HDL-cholesterol (r = 0 0.56 to 0.58) from adolescence to early adulthood.

Osteoporosis. Osteoporosis is a metabolic bone disease characterized by the reduction in volumetric bone density and micro-architectural disorders of bone tissue leading to enhanced bone fragility and consequent increase in the risk of fracture (Ralston, 1997; Duraković, 2003). One out of three women and one in twelve men aged over 50 in the developed world suffer from osteoporosis (Biddle, Gorely, Marshall, Murdey & Cameron, 2004).

We now know that an increase in the maximum bone density achieved at a young age means a longer period of stronger, healthier bones (Zanker, Gannon, Cooke, Gee, Oldroyd & Truscott, 2003; Torstveit & Sundgot-Borgen, 2000). Childhood and adolescence are therefore periods when young people can do the most for the health of their bones in later stages of life with an appropriate diet and sufficient physical activity.

Physical exercise is especially important in the period of accelerated growth. Due to high levels of growth hormone and other factors, around a quarter of the final (adult) bone mass is accumulated (Bailey, 1997) during this period that lasts for about four years (± two years depending on the time of peak height velocity (PHV), which is normally at 12.5 years of age for girls and at 14 for boys (Rowland, 1996)).

The only two solutions recognised as relevant and important preventive (and curative) strategies in the fight to improve the health of people in their youth and later stages of life, are a suitable diet and sufficient physical activity in childhood, adolescence and of course, throughout all later stages of life.

Analysis of the effects of physical activity in childhood/adolescence on lifestyle and health in adulthood

Studies that looked at the long-term permanence of physical activity and physical fitness and at whether these are transmitted from childhood to adulthood are not great in number and show very different results. Some show a very positive influence – others only little or no influence at all. In some cases, it has even been shown that physical activity in childhood can have a negative impact on physical activity in later stages of life.

For greater clarity, I decided to present the results of different studies in three subsections, according to the extent of the effect that they acknowledge.

Effects of physical activity in youth have largely positive effects on physical activity and health in later periods of life. Numerous studies show highly positive effects of physical activity, physical fitness and health status in youth on the lifestyle and health status in later periods of life. Among these we find the Bogalusa Heart Study (Nicklas, Duvillard & Berenson, 2002), which included 1,169 people who were first tested at ages 5 and 14 years, and then again at the ages of 20 and 29.

Based on the measured values of concentrations of "bad" low-density cholesterol (LDL-C), children were classified into three groups: i) an acceptable risk of <2.84 mmol/l (<110 mg/dl); ii) on the risk margin 2.84 to 3.34 (110-129 mg/dl); iii) high risk> 3.35 (> 130 mg/dl).

The prevalence of obesity in adulthood was significantly higher in individuals who had been classified in the high-risk group in childhood (39%), compared to those from the acceptable risk group (24%). The study showed that the concentrations of lipids and lipoproteins present in the blood of an individual during childhood are well maintained also in early adulthood (high traceability). A modified level of low-density cholesterol (LDL-C) in childhood is maintained in adulthood, causing an increased incidence of dyslipidemia, obesity and high blood pressure.

Similar, very positive effects of physical fitness in youth on the lifestyle and health in later periods are also shown by Dennison, Strus, Mellitis and Charney (1988). A group of physically active 25-year-old American men had significantly better physical abilities at the age of 10-11 and in adolescence (between 15 and 18) compared to a group of physically inactive young men. The authors also found that boys who had been ranked below 20 percentile in their performance in running on 600 yards, were much more likely to become physically less active in early adulthood. This clearly shows that individuals who are significantly physically active in childhood are more likely to be physically active in adulthood as well.

The Swedish longitudinal study (Glenmark, Hedberg & Jansson, 1994) also shows that about 25-30% of the variance in the volume of physical activity in leisure time in 27-year-old adults is explained by the aerobic capacity (VO2max) of these people at 16 years of age. Physical capacity (aerobic endurance, muscle strength, physical activity and assessment in physical education) of 16-year-old adolescents can explain 82% of the variance in the time spent on physical activity in 27-year-old women and 47% of the variance in the time spent on physical activity in men of the same age.

A similar positive effect of physical activity and physical fitness in youth on health parameters during middle age is also shown in "*A 25-Year Follow-Up Study*" (Mikkelsson, Kaprio, Kautiainen, Nuppponen, Tikkanen & Kujala, 2004). The most important message of this study is that a high endurance for running (the result of running a distance of 2000 metres) at a young age resulted in a much lower risk of high blood pressure in adulthood.

Studies also show that an active sporting life at a young age does not automatically mean an active life and good health in later periods of life. This remains the key message today in a widely referential longitudinal Harvard study (Paffenbarger, Hyde, Hsieh & Wing, 1986), which researched the effect of physical exercise during student years on the presence of cardiovascular disease and on mortality in subsequent periods. The students were divided into three groups in relation to their physical activity: i) a group of individuals who were involved in competition sports and took part in regular training processes, ii) a group of individuals who were involved in a variety of sport and recreational activities at least five hours per week, iii) a group of individuals who were athletically active for less than five hours per week (often zero).

These groups did not differ from each other in terms of the incidence of cardiovascular disease later in life. The study showed that those subjects who were the most physically active as students but did not exercise regularly after college had the same probability of developing cardiovascular diseases as those students who had never been physically active. Also, the study showed that physical activity had the same health benefits for those subjects who only became physically active later in life as for those who had been active throughout the observation period.

The main message of the study is that the effects of physical exercise on cardiovascular and respiratory functions are short-term and that they wear off after physical activity is stopped. How quickly this happens is not clearly known.

Another highly referential study, *the Amsterdam longitudinal study* (Twisk, Kemper & Van Mechelen, 2002), revealed no significant relationship between physical activity and state of fitness in adolescence and risk factors for cardiovascular disease in adulthood.

The aim of the researchers was to determine the relationship between physical activity and aerobic capacity (VO2max) in young people during adolescence (between 13 and 16 years of age) and risk factors for cardiovascular disease in the same people at the age of 32. The measured factors included blood lipid levels (total cholesterol, high density cholesterol, the relationship between them), systolic and diastolic blood pressure, indicators of body fat and subcutaneous fat distribution (four body folds).

The extent of physical activity during adolescence was not associated with a good health status of the same people aged 32; and a negative correlation was found between VO2max at a young age and some parameters of health status (subcutaneous fat and total cholesterol in the blood) in adulthood. It has been shown that a reduction in physical activity during the period from adolescence to adulthood is associated with unhealthy levels of fat in the blood. The authors conclude that a reduced level of physical activity had a more negative impact on risk factors for cardiovascular disease than a moderate but constant physical activity measured in the period.

The results of the *Northeran Ireland Young Hearts Study* (Gallagher et al., 2002), Danish Youth and Sports Study (Hasselstrem, Hansen, Froberg & Andersen, 2002) and Leuven Longitudinal Study on Lifestyle, Fitness and Health (Lefevre et al., 2002) showed a low but statistically significant positive relationship between physical fitness in adolescence and some parameters of metabolic syndrome (the ratio of total cholesterol, high-density cholesterol, and the amount of subcutaneous fat and/or risk factors for cardiovascular disease (CVD) as a whole) in adulthood (between the ages of 22 and 40). Researchers have not been able to prove a link between the extent of physical activity in adolescence and risk factors for CVD in adulthood.

Danish researchers (Hasselstrem et al., 2002) also found that a change in aerobic capacity (VO2max) is the best predictor of risk factors for CVD (especially for men). Reduction in VO2max is accompanied by an increase in the number of risk factors for CVD, but these vary greatly between different groups of young people. Many young people who attended professional trade schools in adolescence later became physically inactive. On average, their VO2max decreased by 19 per cent, which is much more compared to only four per cent of reduction in VO2max observed in subjects who had attended grammar school.

The effects of exercise at an early age on the physical activity in adulthood can also be negative. Taylor, Blair, Cunnings, Wun and Malina (1999) found a negative effect of physical activity during childhood and adolescence on the extent of physical activity in adulthood.

Their study included 105 middle-aged men (aged 32-60). Based on questionnaires completed retrospectively, the authors assessed the physical activity and health status of the subjects in childhood and adolescence. The subjects were also subjected to a stress test on the treadmill. The results showed that the frequency of physical activity during childhood and adolescence was inversely proportional to the subjects' current physical activity (activity in adulthood). The authors conclude that excessive and vigorous physical activity during adolescence, especially when it is a result of forcing children to exercise by parents, can also have negative effects on the motivation for physical activity in later stages of life.

Analysis of the impact of various programmes, content and complexity of physical activity in youth on the lifestyle and health in adulthood

More demanding and comprehensive programmes are usually more successful in creating a healthy lifestyle. In presenting the results of some studies I want to answer the question 'What impact on physical activity and health in adulthood and old age do school physical education programmes and competitive sports programmes in childhood and adolescence have?'

The results of the *Canadian longitudinal research* (Trudeau, Laurencelle, Tremblay, Rajic, & Shephard, 1998) clearly confirm the importance of large-scale sporting activities in creating a lasting healthy and active lifestyle.

The purpose of the study was to determine the effect of a daily (five times per week) programme of physical education on physical activity and attitudes towards physical activity in adulthood (20 years later). They compared an experimental group (N = 147) who for six years, throughout their primary school years, had five hours of physical education per week (in the 1970s), and a control group (N = 720). The aim of the programme of the experimental group, which was implemented throughout the school years, was to maximise the activities of children during the hours of PE with a view to increasing their aerobic and muscular performance. Activities were carefully staged according to the motor development of children and included some athletic sports, the basics of many team sports, gymnastics, swimming, body expression and various outdoor activities. The PE programme for children in the control group was normal (40 minutes per week under the guidance of their local teacher).

The programme in which the experimental group was involved was proven to increase the total time spent doing physical activity and consequently increased the aerobic power and muscular endurance of the children. Twenty years later, those women who had participated in the experiment as young girls were more physically active; while significantly fewer of the men involved in the programme smoked (11.3% of smokers in the experimental group compared with 30.8% of smokers in the control group). However, the researchers did not find any significant differences between the experimental and control groups in their attitudes to physical exercise.

Another interesting finding confirming that physical activity during childhood and adolescence is an important factor of physical activity in adulthood is presented in the results of a study (Pihl, Matsin & Jürimäe, 2002) which claims that 60% of physical education teachers maintain an active, healthy lifestyle in old age, which is a much higher percentage compared to that of teachers of other subjects. It is interesting that as many as 70% of physical education teachers took part in competitive sports in their youth, compared with only 6% of teachers of other subjects.

The results of some other studies show that larger and more complex programmes for children and youths (school athletic programmes and competitive sports-oriented programmes, etc.) leave deeper and more lasting effects and thus have a greater impact on the activity in later stages of life. In the continuation, I present some supporting examples.

In the *CORDIS Study* (Kraut, Melamed, Gofer & Froom, 2003), which was based on a sample of 3,687 adult industrial workers aged 65-84, the authors researched the impact of organised sports activities at a young age to later physical activity in leisure time. It concluded that extra-curricular sports and various physical activities organised during school years (e.g. training in a sports club) had a significant impact on the level of physical activity in adulthood.

There have been other studies carried out that confirm the fact that participation in competitive sports during adolescence (10 to 19 years of age) is the most important or at least a very important predictor of physical activity in adulthood and mature years (Barnekow & Muijen, 2009; Folgeholm, Sarna & Kaprio, 1999, Glenmark et al., 1994; Telama, Yang, Laaksao & Viikari, 1997; Hirvensalo, Lintunen & Rantanen, 2000).

Finnish researchers (Kujala, Kaprio, Taima & Sarna, 1994) found significant differences between the average population and certain groups of former Finnish top athletes: i) athletes who had been involved in endurance sports (running and cross-country skiing), ii) athletes who had engaged in team sports (hockey, football, basketball), iii) athletes who had been involved in combat sports (boxing, judo). Athletes who had practised aerobic endurance disciplines were showing significantly less expressed risk factors for cardiovascular disease compared with people in the control group and with other athletes; they sought medical care less frequently and were significantly less likely to receive hospital care for heart disease and cardiovascular and respiratory diseases (Table 1). On the other hand, injuries and damage to the locomotor system (chronic damage to knees, hips and spine) were present in endurance athletes in a larger extent than what was the average for the control group. The concern for a healthy lifestyle (regular sporting activity, a healthy diet, lower alcohol and cigarettes consumption) also proved much higher in former endurance athletes than people in the control group (Folgeholm et al., 1994). The generally healthier lifestyle of former top endurance athletes was also reflected in significantly longer life expectancy (Sarna, Sahi, Koskenvuo & Kaprio, 1993) (Table 2).

Table 1: A comparison of the presence of risk factors for cardiovascular disease in athletes of various disciplines and the control group (Kujala, Kaprio, Sarna & Taimela, 1994; Folgeholm et al., 1994).

	ITM > 30	Type 2 diabetes	High blood pressure	Ischaemic heart disease
The control group	12.3	6.7	28.6	19.4
Athletes in total	11.6	4.9*	23.3*	12.7*
Endurance athletes	2.3*	1.7*	20*	9.1*
Runners in the long run	0.0	1.9*	13.6*	5.8*
Nordic skiers	5.6	1.4*	29.2	13.9*
Team sports players and athletes	6.6*	3.0*	22.4*	10.8*
Football	5.0*	2.5*	22.6	11.3*
Hockey	3.4	3.6	20.5	9.8
Basketball	4.5	0.0 *	14.7*	5.9
Athletes	5.6*	3.7*	24.6	12.0*
Athletes practising combat sports	22.8	9.0	26.0	16.9*
Boxing	17.8	11.8	27.2	15.4
Wrestling	23.0	8.5	29.1	19, 9
Weightlifting	28.4	10.4	25.4	22.4
Athletes-weight throwers	25.5	5.1	20.2	11.1*

Legend: BMI = body mass index

Table 2: Life span of athletes of various kinds (Sarna, Sahi, Koskenvuo & Kaprio, 1993).

	Lifetime (years)
Control group	69.9
Endurance athletes	
Long-distance runners	76.8
Nordic skiers	75.0
Sports games players and athletes	
Football	72.5
Hockey	75.7
Basketball	70.1
Athletics	74.5
Athletes practising combat sports	
Boxing	69.8
Wrestling	72.3
Weightlifting	70.0
Athletes-weight throwers	72.6

Research also shows (Sallis & McKenzie, 1991; Cohen, Brownewll & Felix, 1990) that certain sport and physical activity programmes have a more significant impact on the sporting habits and health of adults than others. Both Sallis and McKenzie (1991) note that adolescent activity in some life-long aerobic sports activities such as swimming, jogging and cross-country skiing, has a greater impact on sports and physical activity habits of adults than group sports.

Analysis of heritable and environmental influences on lifestyle and health in adulthood

The general health condition and a healthy lifestyle in adulthood also depend on genetic factors and on the effects of the family environment. A study (Simonen, Videman, Kaprio, Levälahti & Battié, 2003) assessed the physical activity of 117 pairs of identical twins from their 18th year of age. The most important influence on the attitude towards physical activity in adulthood was discovered in hereditary factors, combined with family lifestyle and followed by participation in competitive sports in adolescence (between the ages of 12 and 18).

Both factors together explained 69% of variance in individual differences in practising sports and recreational activities in adulthood; about one-third of the variance is explained by the authors with other factors, such as knowledge and understanding of healthy lifestyle factors, personality traits, etc.

DISCUSSION AND CONCLUSIONS

Perhaps the first and most important message of this paper is that, despite the great interest in the scientific study of the issue, the question whether an active lifestyle and associated good health that is developed during childhood and adolescence is transferred to adulthood and old age does not yet have a completely clear answer.

The results show that the links between sport/physical activity during childhood/adolescence and adulthood are low ($r = 0.09$ to 0.25) and that they decrease with increasing the range of the observation interval.

Given the basic rules of sports activities, which claim that only regular and appropriately challenging exercise can have a positive effect on physical fitness and health of individuals, this is logical and expected. It is also known that the biological effects of exercise (biochemical, physiological, neuromuscular and other) after cessation of exercise wear off relatively quickly. This was also very clearly demonstrated by the Harvard and Amsterdam studies (Paffenbarger, Hyde, Hsieh & Wing, 1986; Twisk, Kemper & Van Mechelen, 2002). Cumulative health effects of exercise, therefore, can only be expected with regular and systematic exercise throughout the entire lifetime. A greatly important role that activity at a young age plays is also in the formation of habits and values that ensure that a healthy lifestyle developed in youth is continued in the later stages of life. People who go through extensive experiences in physical activity in their youth have a more positive attitude to sport in adulthood. This is also confirmed by the authors of several studies (Sarna, Sahi, Koskenvuo & Kaprio, 1993; Kujala, Kaprio, Sarna & Taima, 1994; Folgeholm et al., 1994), in which they show that former top endurance athletes in their third age are healthier than ordinary people, mainly due to a healthier and more active lifestyle, which they keep up even after the end of their professional careers.

Young people need to do more sports! The important conclusion of the analysis of research results is the recognition/validation of the expected fact: that a larger extent and frequency of physical activity and a systematic sports programme for children and youth undoubtedly mean a better physical performance and lower risk factors for the development of metabolic syndrome symptoms and later cardiovascular disease, osteoporosis, etc. By reducing physical activity, the risk of developing MS increases significantly (Kelishadi et al., 2006; Kelishadi et al., 2007; Raitakari, Porkka, Taima, Talama, Räsänen & Viikari, 1994). At the same time, it is important to consider the fact that inactivity and a low level of aerobic capacity are not only related to individual factors of MS, but are also strong predictors of developing MS in later periods. People with oxygen consumption (VO2max) of less than 29.1 ml/kg/min, have a nearly seven times greater chance of developing MS compared with those with a VO2max equal to or greater than 35.5 ml/kg/min (Lakka, Laaksonen, Lakka, Niskanen, Kumpusalo, Tuomilehto et al., 2003).

The complexity of the issue of determining and explaining the relationship between sport and physical activity in childhood/adolescence and adulthood is also largely methodological. There are two fundamental problems:

i) Difficulty of implementation of long-term longitudinal studies

Only with permanent monitoring of large numbers of children with active and inactive lifestyles throughout life (which is impossible) would we be able to come up with complete answers to the question. All other methodological approaches leave a certain degree of openness, which leads to a relatively high diversity or disunity in the results.

ii) Reliability of data on measured levels of physical activity of a person

Data on the extent and intensity of physical activity in different studies are obtained with different methods (questionnaires and/or interviews, measurement of heart rate, distance and intensity of the movement and pedometric/accelerometric measurements). Each has its drawbacks, which reduces the total objectivity of the obtained data. Even more pronounced than that is the question of the objectivity of the results comparison, which were obtained by different methods.

Therefore, for better illumination of this issue, we need more extensive longitudinal studies, which will be based on technologies with a more reliable manner of measurement of physical activity.

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HEART RATE, MOOD STATES, AND RATING OF PERCEIVED EXERTION AMONG ELDERLY SUBJECTS DURING 3.5 HOURS OF RECREATIONAL ALPINE SKIING

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ABSTRACT

A decline in physiological functioning and mental wellbeing is common with advancing age. However, these changes may vary among elderly individuals. Physical activity and the response of the elderly to exercise during recreational activities, i.e., recreational alpine skiing, may serve as a catalyst for the improvement of wellbeing and general health. ***Purpose:*** *The aim of the study was to assess the heart rate (HR) response modulations in a group of elderly recreational alpine skiers during 3.5h of skiing. In addition, each group's perceived responses of mood state (MS) and rating of perceived exertion (RPE) were collected to determine possible contributions to changes in wellbeing as a result of recreational skiing.* ***Methods:*** *Forty-nine healthy elderly participants (mean age: 63±6 yrs, weight: 75.4+13.1 kg, height: 170.5+9.1 cm, BMI: 26+3.2) with at least basic alpine skiing ability participated in a 3.5h ski test. GPS data (GPS Garmin Forerunner 301) were used to monitor altitude and HR and were recorded continuously during the 3.5h of skiing. During skiing, participants were asked at three different times to report RPE and MS.* ***Results:*** *The time spent on the lift during the 3.5h skiing ranged from 21-58% followed by recovery breaks of 17-53% and time spent in downhill skiing ranged from 12-40%. Participants completed 9-23 downhill runs in 3.5h. Average intensities during 3.5 h downhill runs for over 80% of the* *group were between 50-80% of maximal heart rate (HRmax) (220-age). Peak heart rate (HRpeak) values during downhill runs for 35% of the group were between 60-70% of HRmax. Statistical analysis revealed numerous significant differences between RPE and MS values for the three different sampling times. The MS in general remained positive and even increased in the categories of happiness and sociability despite an increase in fatigue.* ***Conclusion:*** *The results of this study suggest that the duration and intensity of skiing was appropriate and yielded immediate positive psychological effects on the elderly subjects. Furthermore, recreational alpine skiing has a positive effect on MS ratings reflecting wellbeing, while generating age-appropriate moderate RPE values in elderly alpine skiers.*

Keywords: *aging, wellbeing, alpine skiing, mood states*

SRČNI UTRIP, RAZPOLOŽENJE IN NAPOR STAREJŠIH OSEB MED 3,5-URNIM REKREATIVNIM ALPSKIM SMUČANJEM

IZVLEČEK

Zmanjšana telesna aktivnost in slabše duševno počutje sta v starosti pogosta pojava, vendar pa se med starejšimi te spremembe precej razlikujejo. Telesna aktivnost in pripravljenost na izvajanje rekreativnih dejavnosti, kot je na primer rekreacijsko alpsko smučanje, lahko starejšim ljudem pomaga izboljšati počutje in splošno zdravje. ***Namen:*** *Cilj študije je bil oceniti odzivne modulacije srčnega utripa (SU) v skupini starejših rekreacijskih alpskih smučarjev med 3,5 urami smučanja. Poleg tega smo zbirali podatke o zaznanih spremembah v razpoloženju (R) in o lastni oceni zaznanega napora (OZN) pri vsaki skupini, da bi določili, kakšen doprinos k izboljšanju počutja ima lahko telesna vadba.* ***Metode:*** *Devetinštirideset zdravih starejših udeležencev (povprečna starost: 63 ± 6 let, teža: 75,4 ± 13,1 kg, višina: 170,5 ± 9,1 cm ITM: 26 ± 3,2) z vsaj osnovnim znanjem rekreativnega smučanja je sodelovalo v 3,5-urnem smučarskem preizkusu. Za spremljanje sprememb srčnega utripa glede na nadmorsko višino smo zapisovali podatke GPS (GPS Garmin Forerunner 301), ki so se v času 3,5-urnega smučanja neprestano shranjevali. Udeležence smo med smučanjem na treh različnih točkah prosili, da poročajo o svoji OZN in R.* ***Rezultati:*** *Čas, porabljen za vzpone med 3,5 urami smučanja, je nihal med 21–58 %, sledili so odmori za počitek v razponu 17–53 %, najmanj pa je bilo časa, preživetega v dejanskem smučanju, ki je znašal 12–40 % vsega preživetega časa aktivnosti. Udeleženci so opravili 9 do 23 spustov v 3,5 urah. Povprečne intenzivnosti med 3,5-urnim spustom so pri več kot 80 % udeležencev znašale med 50–80 % maksimalnega srčnega utripa (SUmax) (220-starost). Najvišje vrednosti srčnega utripa (SUvrh) med spustom za 35 % udeležencev pa so znašale med 60–70 % SUmax. Statistična analiza je pokazala številne znatne* *razlike med vrednostmi OZN in R v treh različnih časih vzorčenja. R je na splošno ostal pozitiven in se je kljub povečani utrujenosti celo povečal v kategorijah veselja in družabnosti.* ***Zaključek:*** *Rezultati raziskave kažejo, da sta bila trajanje in intenzivnost smučanja primerna in sta imela na starejše osebe takojšnje pozitivne psihološke učinke. Poleg tega je bilo dokazano, da ima rekreativno alpsko smučanje pozitiven vpliv na ocene R, ki se odražajo v dobrem počutju, hkrati pa ustvarjajo starosti primerne zmerne spremembe vrednosti OZN pri starejših rekreativnih smučarjih.*

Ključne besede: *staranje, dobro počutje, alpsko smučanje, razpoloženje*

INTRODUCTION

The decrease in physical functioning associated with advancing age is often accompanied by a reduction in psychological abilities. However, the degree of age related functioning is not determined by the aging process alone; it often depends on individual lifestyle as well (Hollmann & Hettinger, 2000). A physically active lifestyle contributes to better physical functioning and mental health. The physically active elderly can often compensate for diminished functioning by energizing their innate assets more effectively when compared to sedentary individuals, as reported by Olbrich (1987, 1992; Kirchner & Schaller, 1996; Israel, 1995). Therefore, a suitable exercise regimen is generally based on the intensity, duration, and frequency of exercise recommended for individuals within a specific age range (American College of Sports Medicine, 1998).

The American College of Sports Medicine (1998) recommends training intensities between 60 - 90% of maximal HR (HRmax) for 30 - 60 min 3 - 5 times per week to improve cardiovascular health. Pahlke (1995) reported that aerobic exercise is an important factor in maintaining and improving the cardiovascular system and sustaining overall health and wellness during the aging process.

In addition to the physiological components, psychological wellbeing, positive MS, and motivation are equally important and contribute to improved overall health in the elderly (Samitz & Mensink, 2002).

Alpine skiing as an athletic and recreational activity is a small part of global sports. However, in snowy mountainous regions it is an integral part of the lifestyle of both young and old. Recreational alpine skiing thus potentially offers significant physical and psychological improvements for the elderly.

Although alpine skiing in the mountainous regions has a long tradition, it has not often been viewed a beneficial sport for seniors. Prokop and Bachl (1984) describe alpine skiing as risky due to high physical strain and psychological stress. However, in the last few years, the focus has been shifting to recreational skiing and the resulting psychobiological benefits for skiers, especially the elderly. Kahn and Jouanin (1996) as well as Vater et al. (2005) support alpine skiing's preventative function and its promotion of general wellbeing among the elderly. However, the majority of studies assessing recreational skiing have used more rigid test designs utilizing prescribed skiing patterns, allowing little latitude for individuality as it would normally occur during free skiing.

Therefore, the purpose of this study was to monitor HR responses that partially reflect physiological demands and to collect subjective ratings of effort and individual mood state via a questionnaire in a representative group of elderly recreational skiers as they skied in their habitual skiing patterns.

METHODS

Participants

Forty-nine apparently healthy volunteer elderly individuals participated in our study. Participants were > 50 years of age with at least basic alpine skiing abilities and were were recruited via personal contact and word of mouth. The participant group consisted of 16 women [mean age: 60.4±4.4 yrs, weight (Wt): 65.7+10.2 kg, height (Ht): 162.5+5.8 cm, body mass index (BMI): 26.3+2.6] and 33 men [mean age: 64.5±6 yrs, Wt: 78.9+12.3 kg, Ht: 173.4+8.3 cm, BMI: 25.9+3.5] with a combined mean age of 63.4+63, Wt: 75.4+13.1 kg, Ht: 170.5+9.1 cm, BMI: 26.0+3.2. Currently, there are no data available in the literature similar to or representative of our study with respect to elderly recreational skiers.

The skiing ability of our elderly subjects ranged from basic to expert. Participants were classified according to the Austrian Ski Teaching Concept (Wörndle, 2007) as determined by a certified Austrian ski instructor.

Participants were given a questionnaire in which they were asked to describe their general exercise behavior. The questionnaire revealed that 62% of the women and 57% of men were involved in more than 5 h of sports per week. Forty-nine percent of the group described the exercise effort as easy and 51% as demanding during their typical 5 h of exercise. Regarding exertion level, 37 participants reported some degree of physical discomfort in general. Of those 37, 25 complained of knee problems and 19 of lower back problems.

Thirty participants skied > 28 days per year. Two participants skied 22-28, 4 had 15-21, 10 had 8-14, and three skied less than eight days per year. A common skiing day varied among participants from 2-8 hours.

The physical working capacity test up to a HR of 130 beats per min (bpm) (PWC130) was conducted on an electronically braked cycle ergometer (Kettler CX1, Kettler, Salzburg, Austria) a week after the skiing session to determine the physical fitness of the participants. The combined group averaged 1.7 ± 0.3 W.kg-1measured during the PWC130 test. Women averaged 1.5 ± 0.3 W.kg-1 and men 1.7± 0.3 W.kg-1.

Sixteen participants were taking prescribed hypertension medication that may have influenced HR response during testing; however, there were no significant differences in HR responses during skiing between medicated and non-medicated participants. We therefore elected to treat medicated and non-medicated subjects as a single group.

Study design

This study was approved by the local ethics committee and written informed consent was obtained from all participants prior to testing. Subjects participated in a total of 3.5 h of skiing field testing on the slopes of Hinterreit in Salzburg, at an altitude of 780-1180 m. The ski area has three different slopes serviced by two T-bar lifts. Vertical altitude difference for the lower lift was 246 m and required on average a 6-min T-bar lift to reach the top of the lift. The vertical altitude difference for the upper ski lift was 288 m and required a ride of ~5-min. The selected ski area consisted of a variety of open ski slopes. Ski steepness ranged from <25% to a nearly 40% grade. Participants were free to select their preferred slopes.

The weather conditions were sunny to light cloudiness without condensation. Temperature throughout the testing days was consistently between -6 to -2 °C in the mornings to +4 to +8 °C in the afternoons.

The field-test protocol was explained in detail to all participants until all aspects of the testing were understood. The participants were subsequently fitted with a HR chest strap and global positioning system (GPS) monitoring equipment (GARMIN Forerunner 301, Garmin©, USA) on the upper arm. Data were recorded continuously during skiing in all participants. Participants started skiing at 10:15 AM. They were asked to ski as they normally would and at a speed comfortable for them, and to feel free to rest on the slopes when desired.

The duration and frequency of skiing were measured by analyzing the time of actual downhill runs and recovery breaks. These two combined constituted a single cycle. Downhill run time was defined by changes in altitude. The recovery phase was defined as the time between two downhill runs, consisting of T-bar lift use and break time before and after T-bar lift use (Figure 1). An example of HR response for a single subject during three downhill runs and T-bar use/recovery as a function of altitude is also shown in Figure 1. To describe cycle characteristics, a relationship between length of recovery and downhill skiing run time was calculated. Thus, recovery time was divided by the time of the downhill runs.

Physical exertion during downhill runs and recovery time were assessed via HR response throughout the skiing periods and during T-bar lift use. The mean HR (HRmean), as well as peak HR (HRpeak) and minimal HR (HRmin) during downhill runs and during T-bar lift use were used to estimate the intensity of exertion among the elderly skiers during skiing. T-bar lift use and downhill runs were determined by differences in altitude as recorded by the GPS.

The mean HR was determined using the average HR for all downhill runs for each individual. Peak HR represents the highest HR achieved during each downhill run and averaged for all downhill runs. Similarly, the minimal HR represents the lowest HR measured during T-bar lift use.

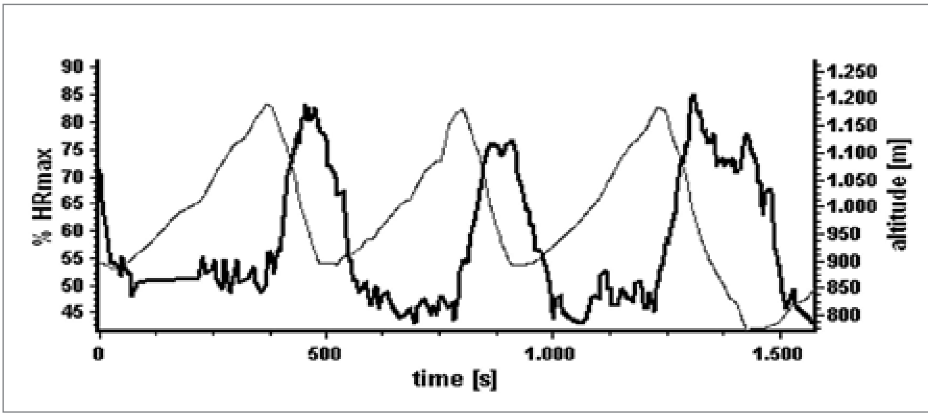

Figure1: Example of heart rate (HR) response for a single subject during 3 consecutive downhill-runs and T-bar use/recovery phase as a function of altitude.

In our study we express HR as percentage of maximal HR using the following formula HRmax = 220-age, knowing that there may be differences between estimated HRmax and actual achieved maximal HR. However, due to the age of the participants and for logistical reasons, the age related formula was used to represent HRmax values, in accordance with Karvonen and Vuorimaa (1988).

To determine the individual mind-set that would reflect the physical sensations of skiing, each participant was asked to answer questions regarding their perception of MS using the Hackfort and Schlattmann (1995) questionnaire consisting of a 10-point scale from 0 = none to 10 = in complete agreement, and including the following nine dimensions: readiness for the activity, sociability, self-confidence, happiness, nervousness, fatigue or exhaustion, anger, worry, and concentration (Hackfort & Schlattmann, 1995). A positive MS was expressed along the following five dimensions: readiness for the activity, sociability, self-confidence, happiness, and concentration, while the negative MS dimensions were expressed in terms of: nervousness, fatigue and exhaustion, anger, and worry.

Exertion ratings were estimated using Borg's 15-point scale (6 = no effort to 20 = complete exhaustion; Borg, 1985). The MS questionnaire and RPE for each individual were determined at 0.5 h (T1), between 1.5 - 2 h (T2) and at the end of 3.5 h of skiing (T3). Data for HR and GPS were analyzed using "Training Center 2.3", Sports Tracks (Garmin©, Olathe, Kansas, USA) and Ikemaster (Ike Software Solutions, Salzburg, Austria) software, and were analyzed statistically with SPSS v. 15.0 statistical software (SPSS, Chicago, IL, USA).

One-way repeated measures analysis of variance, Mann-Whitney U-Tests, and Wilcoxon Sign-Tests were used to evaluate RPE values, the questionnaire scale for MS, ans HR and GPS data. Significance was set at an alpha level of $p \leq 0.05$.

RESULTS

The skiing group covered a mean vertical distance of 4,370 ± 956 m during testing. The range of vertical distance values covered by the group was between 1,971 and 6,211 m.

Time spent on the T-bar lift was 43±8% (range 21%-58%), downhill ski runs 19±5% (range 12-40%) and break time was 38±9% (range 17-53%) for the 3.5 h ski testing day.

The recovery to downhill runs ratio ranged from 4:1 (6 min recovery to 1.5 min downhill runs = 4:1) to 1:1 (10 min recovery to 10 min downhill runs = 1:1). Participants completed between 9-23 downhill runs in the allotted time.

Mean heart rate (HRmean) within the group during downhill runs was 70±10% of maximal HR (HRmax). Mean HR (HRmean) for the group during lift runs was 60±10% of HRmax. Mean peak HR (HRpeak) for downhill runs was 76±12%. Mean minimal HR (HRmin) recorded for T-bar lift runs was 54±9% of HRmax. HR responses during skiing for the male, female, and combined groups are depicted in Table 1.

Table 1: Heart rate (HR) response (peak and mean) for combined group (CG), male and female group for the 3.5 h skiing session. Values are mean + SD; (N = 49).

Variable	Combined Group Mean + SD (N=49)	Males Mean + SD (N=33)	Females Mean + SD (N=16)
HRpeak (bpm)	119.7 + 18.4	123.9 + 19.9	111.0 + 11.0
HRmean (bpm) (overall)	106.8 + 22.5	109.0 + 26.4	102.3 + 10.1
HRmin (bpm) (lift/recovery)	93.2 + 15.0	93.8 + 23.6	85.8 + 8.3

bpm = beats per minute; HRpeak = peak heart rate; HRmean = mean heart rate; HRmin = minimum heart rate

Forty percent of the group had HRmean values during downhill runs between 60-70% of HRmax; 26% had HRmean between 70-80%; 15% were between 50-60 % and 2% of the group had HR below 50% or in some cases above 90% of HRmax. Fourteen perecent had HRmean of 70-80%, 24% had HRmean of 60-70%; 44% had HRmean of 50-60%, and 14% had HRmean below 50% of HRmax during T-bar lift use (Figure 2).

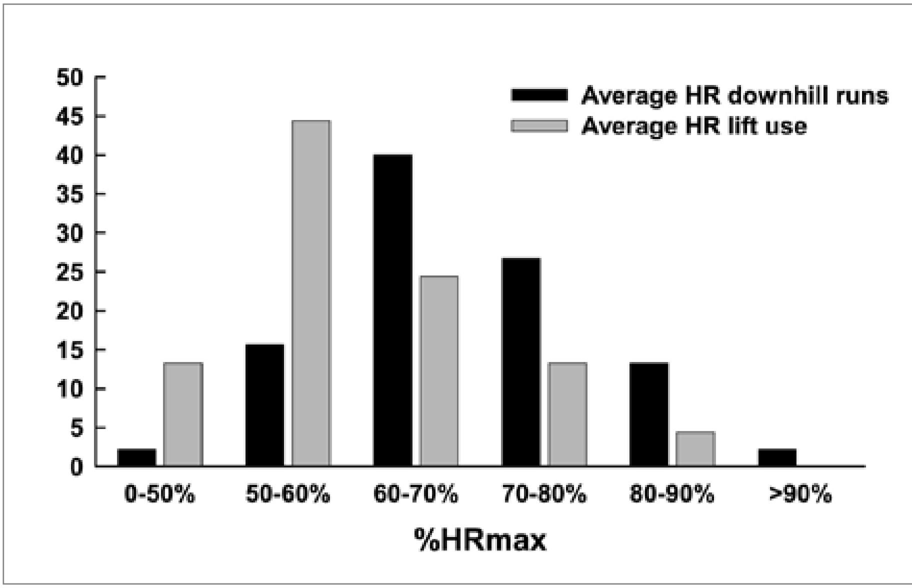

Figure 2: Mean heart rate (HR) response during downhill runs and T-bar use during the 3.5 h recreational skiing session for the combined group (N = 49).

Thirty-five percent of the group had a peak HR that corresponded to 60-70% of maximal HR. Twenty-four percent had a peak HR that was 80-90% of HRmax and 22% had HRpeak values of 70-80% HRmax. Fifteen percent of the group had HRpeak above 90% of HRmax and 4% reached 50-60% of HRmax (Figure 2).

Positive MS scores ranged from 7.7±0.1 to 9.0±0.3 for all time points for the combined group. Negative MS ranged from 0.2±0.5 and 1.1±0.5. Statistically significant differences were found for positive and negative MS scores over time between T1, T2 and T3 and for negative MS over the entire skiing session (Figure 3).

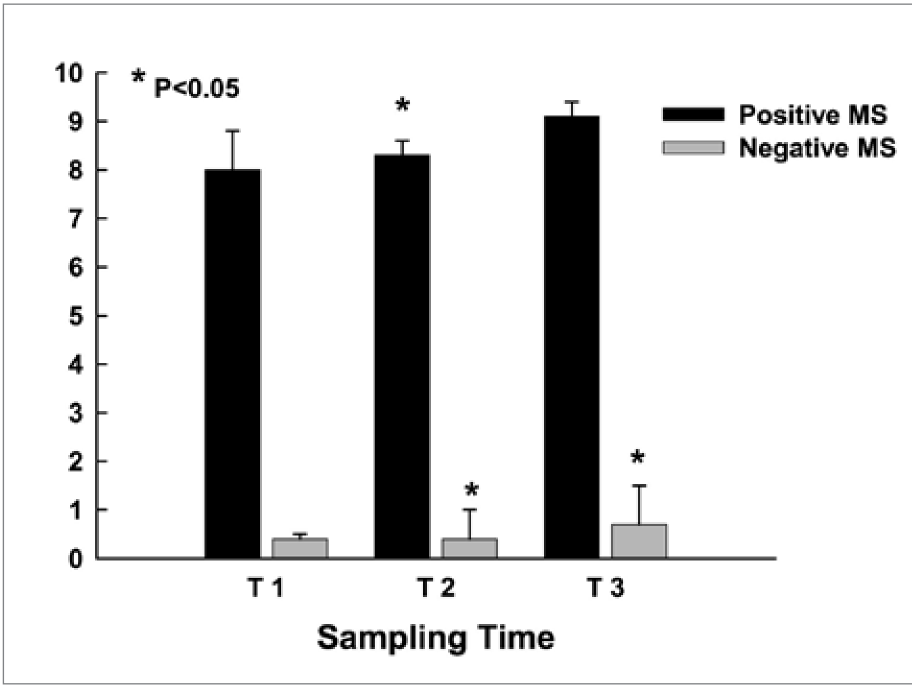

Figure 3: Mood states (MS) score recorded at 3 designated time points during 3.5 h of recreational skiing for all participants (N = 49). Values are mean + SD.

Significant changes were also found for certain dimensions of MS and between recorded time periods. Fatigue increased between T1 and T3 (p=0.001), between T2 and T3 (p=0.001) and over the entire skiing session (p=0.001). Sociability increased between T1 and T2 (p=0.01) and between T1 and T3 (p=0.017) and for the entire session (p=0.005). Happiness yielded an increase between T1 and T2 (p=0.04) and over the entire skiing session (p=0.03). Dimensions describing activity, concentration, self-confidence, nervousness, anger and depression were not significantly different during the 3.5 h of skiing (Figure 3).

Ratings of perceived exertion for the entire group revealed significant increases between T1-T2 (p=0.04), T1-T3 (p=0.001) and the entire session (p=0.001) (Figure 4).

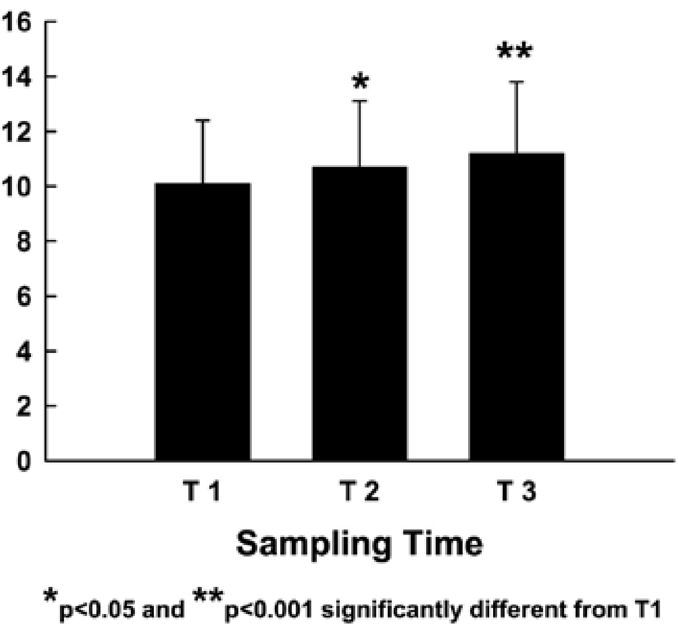

Figure 4: Ratings of perceived exertion (RPE, Borg Scale 6-20) recorded during 3 designated sampling times of 3.5 hours of recreational skiing for the combined group of participants (N = 49). Values are mean + SD.

DISCUSSION AND CONCLUSIONS

When assessing the variables that describe the intensity, HR responses, and physical demands of recreational skiing in the elderly, the results of our study lend support to the guidelines recommended by the American College of Sports Medicine (ACSM, 1998; Hollmann & Hettinger, 2000) as well as Prokop and Bachl (1984). Sixty-five percent of our elderly participants skied within the health-promoting domain of 60-80% of maximal HR (ACSM, 1998). For a few participants within our group, the intensity during T-bar lift use was above the level of minimal demand and may have minimally influenced the cardiovascular system. Participants who exhibited a higher physical exertion on downhill-runs observed during high relative HR values may have been psychologically more willing to accept higher intensities and physical demands compared to others in the group.

Heart rate alone does not reflect all of the metabolic or physiological responses and, as reported by Seifert et al. (2008), should not be viewed as the sole factor indicative of physical fatigue. In our study, the measured HR does, however, provide a broader indication of the level of physical exertion experienced by the elderly during skiing. Our participants were free to ski using their preferred skiing styles and patterns. They were not under any specific mental pressure or psychological stress, as was reflected in their higher ratings of positive mood states. We therefore postulate that psychologically based influence did not affect HR response during skiing and was not a major factor that would alter the results of our study.

The average HR values combined with cycle characteristics (recovery to downhill run ratio) in our study clearly show that alpine skiing is not a steady-state continuous activity like walking, jogging, running, or cycling. It is a mixture of high and low intensity activity and could be characterized as an intermittent activity (Zintl, 2001). The continuous type of steady-state, moderate-intensity activity is generally prescribed to increase aerobic capacity and is therefore more commonly adhered to when participating in an activity or as recommended exercise for the elderly.

During alpine skiing, the duration of stimuli is based on individual preferences and the characteristics of ski slopes, especially length and steepness. Therefore, the characteristics of the intensity and recovery cycle often depend on slope characteristics. The ski slopes in our ski testing area were comparatively short. This affected not only cycle characteristics but also the number and duration of breaks during downhill runs.

The variables describing differences in altitude are also affected by the characteristics of the testing area and its setting. Variables that were measured included the steepness and length of the slopes as well as T-bar lift speed. The skiing pattern of each individual skier was determined by measuring frequency of breaks, preferred skiing speed, radii and length of turns modulate the variables describing differences in altitude to varying degrees. Large differences in vertical distance skied may be due to variations in skiing proficiency level, whereas smaller differences may be accounted for by other reasons and cannot be explained by a single factor. Therefore, the vertical distance covered during skiing, expressed in meters, could only be compared for a single subject. Each subject's skiing may be influenced by the characteristics of the skiing area and skiing conditions.

During skiing sessions, the person with the shortest downhill run time did not ski for less than 25 min of absolute skiing time in the 3.5 h session. The longest absolute time spent on downhill runs was 84 min. Due to the large variability in skiing time among our participants, physical exertion time (absolute skiing time) was variable. Participants who utilized the shortest absolute skiing time were near or below the threshold for physical activity that may serve to improve fitness, as suggested by ACSM (1998). Heart rate values during skiing did not correlate with break time, skiing time or lift time within the group. We postulate that this was due to the lack of standardizing of skiing technique, style, and speed. Participants were allowed to vary the length and number of breaks and to elicit their individual preferred intensity, resulting in mostly moderate exertion levels. These were subsequently reflected in moderate RPE scores.

Although, there was a significant increase in the sense of exertion reported, RPE rating remained in the lower third on the Borg scale even at the end of the skiing session. Hence, a moderate feeling of physical exertion associated with skiing intensity was not indicative of fatigue or exhaustion. This finding is consistent with the below-threshold intensity that contributes to benefits from sports activities recommended for the elderly (Hollmann & Hettinger, 2001; ACSM, 1998; Prokop & Bachl, 1984).

The high scores recorded for the positive MS categories at the first measurement (T1) may be viewed as anticipatory since participants knew that they had another 3 h of skiing available to them. As a few participants were unfamiliar with the setting, we interpret these findings as an indication that participants were becoming comfortable with the test setting and conditions after the initial 30 min of skiing. Therefore, recreational skiing appears to increase individual drive and motivation for the physical activity that is an important factor in sports and physical activity in the elderly, as reported by Dahlhaus (2004).

The first administration of the questionnaire (30 min) revealed positive responses for MS and numerous categories of positive MS increased with the additional 3 h of skiing. High positive MS scores were recorded for the dimensions of happiness and sociability during the ski session, even though there was an increase in the feeling of fatigue. Our results agree with Samitz and Mensink (2002), who suggest that recreational alpine skiing represents a positive and inspiring MS activity for the elderly.

As described by Grosser et al. (2001), the physical demands of sport and exercise are influenced by internal and external factors. In alpine skiing, internal factors include individual skill level, style and technique, in addition to physiological capacity and motivational factors. External factors include the characteristics of ski slopes such as steepness and length, ski lifts, weather, snow conditions, crowded skiing conditions, and use of skiing equipment, to name a few as described by Vater et al. (2005). External factors may be influenced by pre-screening and other sources of information detailing the infrastructure of the skiing area and resorts, and possibly also by the choice of skiing equipment.

It is difficult to discern a direct relationship of HR to various internal and external factors due to the complexity of activity, and therefore we did not expect to find a direct relationship or cause and effect of each variable that may be responsible for the overall perception of the stress and demands of skiing. In a different study with a similar age group of participants, the authors found no direct relationship between physical fitness and HR response during recreational skiing (Krautgasser et al., 2009). Similar results were reported by Scheiber et al. (2009). They found only low correlations between PWC130 and exertion level in a group of elderly skiers of equal skill level. The authors concluded that the participants controlled skiing intensity to avoid fatigue. Their results support our assumption that, based on an amenable selection of skiing terrain and slopes, better skilled skiers vary their skiing intensity, unlike less skilled skiers, who appear to resort to reduced speed in order to better control skiing intensity, and who take longer break times to avoid fatigue. Although we did not find a direct correlation between physical exertion and mood states during free recreational skiing, physical fitness is highly desirable and offers the possibility of beneficial exercise response, especially for individuals with a predisposition for cardiovascular diseases as reported by Burtscher et al. (2005) and Burtscher (2007).

In accordance with the findings of Faulhaber et al. (2007a) and Faulhaber et al. (2007b), our results suggest that elderly skiers should take into account any existing health problems, avoid unnecessary risk of injury, and recognize their physical limitations in order to maximally benefit from exercise and physical activity. The results of our study support the findings of other investigations indicating that alpine skiing positively affects physical and psychological wellbeing as well as mood state among elderly recreational skiers.

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THE EFFECTS OF A SIX-MONTH TRAINING PROGRAMME ON RUNNING ENDURANCE, MORPHOLOGICAL CHARACHERISTICS AND SOME AEROBIC ABILITY PARAMETERS OF ADULT WOMEN WITH DIFFERENT PHYSICAL ABILITIES

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ABSTRACT

This study reveals the results of a six-month training programme between a recreational group of previously physically inactive women (Group 1) and an already regularly active recreational group of female runners (Group 2). The sample consisted of 28 women, 13 in Group 1 (age (yr) = 41.7 ± 14.3, BMI = 26.8 ± 3.4) and 15 in Group 2 (age (yr) = 38.3 ± 7.8, BMI = 21.5 ± 1.7). Despite different initial values, the results in both groups showed an improvement in measured parameters that were more pronounced in Group 1; however, in comparisons carried out between the two groups, only Group 1 achieved a statistically significant improvement in relative maximal oxygen uptake (ml/min/kg). The results demonstrate that the recommendations of the World Health Organization (WHO), whose guidelines suggests at least 30 min of physical activity per day, are suitable for improving and maintaining functional abilities, including those of previously inactive groups (Group 1) as well as recreational groups (Group 2) of female runners.

Keywords: *recreation programme, endurance, untrained, trained*

VPLIV ŠESTMESEČNEGA VADBENEGA PROGRAMA NA TEKAŠKO VZDRŽLJIVOST, MORFOLOŠKE ZNAČILNOSTI IN NEKATERE KAZALCE AEROBNE ZMOGLJIVOSTI ODRASLIH ŽENSK Z RAZLIČNO ZAČETNO ZMOGLJIVOSTJO

IZVLEČEK

Študija predstavlja rezultate šestmesečnega vadbenega programa, v katerem so sodelovale odrasle ženske, ki so bile prej gibalno/športno neaktivne (Skupina 1) ter skupina že redno gibalno/športno aktivnih odraslih žensk (Skupina 2). V študiji je sodelovalo 28 merjenk, 13 v Skupini 1 (starost (let) = 41.7 ± 14.3, ITM = 26.8 ± 3.4) in 15 v Skupini 2 (starost (leta) = 38.3 ± 7.8, ITM = 21.5 ± 1.7). Učinek vadbe je opazen v napredku obeh skupin, izrazitejši pa je v Skupini 1, ki je tudi statistično značilno napredovala v vrednosti relativne maksimalne porabe kisika (ml/min/kg). Rezultati predstavljene študije nakazujejo, da so priporočila Svetovne zdravstvene organizacije, ki predvideva vsaj 30 minut gibalne/športne aktivnosti dnevno, ustrezna za izboljševanje kot tudi za ohranjanje funkcionalnih sposobnosti tako že gibalno/športno aktivnih kot tudi prej neaktivnih odraslih žensk.

Ključne besede: *vadbeni program, vzdržljivost, netrenirani, trenirani*

INTRODUCTION

Regular physical activity significantly reduces the risk of cardiovascular disease, type 2 diabetes, colon cancer, breast cancer, endometrial cancer and many other chronic diseases (Pratt, 1999; Bize, Johnson & Plotnikoff, 2007; McGavock, Anderson & Lewanczuk, 2006); it reduces depression and increases feelings of overall satisfaction (WHO, Blinc & Bresjanac, 2005); and it is also closely associated with the lifestyle of an individual (Bize et al., 2007). Exercise as a field of physical activity is a planned, organised and repetitive bodily movement carried out with the intention of improving and/or maintaining physical well-being. Most physiological adaptation to physical activity is beneficial for maintaining health. Physical activity increases insulin sensitivity, improves the metabolism of triglycerides and cholesterol and reduces the basal activity of the sympathetic nervous system, which in turn reduces atherothrombotic complications in coronary and cardiovascular disease. People who are regularly physically active extend their lives by approximately two years on average in comparison to inactive people (Blair, La Monte & Nichaman, 2004). Particularly, it is possible to maintain endurance and muscle strength in old age, which in turn maintains functional capability, enabling and extending the period of independent living (Blinc & Bresjanac, 2005).

Bodily composition changes noticeably from youth to becoming older (Carter & Heath 1990; WHO Heyward & Wagner, 2004; Astrand & Rodahl, 1986). With age, the accumulation of abdominal and visceral fat in the abdominal cavity increases, which is an important factor associated with mortality in the elderly. Old age is also accompanied by a characteristic decline in muscle mass, which is associated with a decrease in functional ability and progressively leads to a loss of independence (Kemmler et al., 2010). Regular physical activity reduces many of the negative effects of aging on body composition while at the same time maintaining and evening improving functional capabilities. The World Health Organization (WHO) and most health-related professional associations recommend at least half an hour of moderate and vigorous physical activity daily for adults. This means intensity of approximately 3-6 Metabolic Equivalents (MET), respectively more than 6 METs. However, many of these groups have already pointed out that, due to a sedentary lifestyle, this amount of physical activity is not enough to prevent an unhealthy weight gain. In addition to ensuring a reasonable amount of physical activity, it is also necessary to control the caloric intake of food (Blair, Lamont & Nichaman, 2004).

Aerobic exercise has extremely positive effects on overall health and well-being (Ransford & Palisi, 1996). Aerobic capacity is demonstrated and evaluated by the parameter called the maximal oxygen consumption (VO2max). People with a VO2max value below 29.1 ml/kg/min are nearly seven times more likely to develop at least one of the factors of metabolic syndrome than those with a VO2max values equal to or greater than 35.5 ml/kg/min (Lakka et al., 2003). Despite a repeatedly proven strong connection between physical inactivity and susceptibilities for various diseases, more than half the population is still barely or completely physically inactive (Dunn et al., 1999). Understanding the consequences of physical inactivity is a great help in developing effective training programmes to achieve the recommendations of the World Health Organization (WHO) for at least 30 minutes of daily physical/sports activity. In practice, sports and recreation programmes have to be varied and interesting in order to attract and motivate people to exercise regularly over a long period of time. At the same time, trainers have to be prepared to objectively evaluate the effects of training programmes and progress (Bishop & Milic, 2009; Bishop & Milic, 2010). The study aimed to establish the effect of complex recreational exercise on the running preparedness of adult women and find out the extent to which individual mechanisms of aerobic capacity respond to a complex running exercise programme.

METHODS

The sample of subjects

The sample consisted of 28 women. Depending on the individual runner's willingness and on the results of functional tests, they were divided into two groups according to the experience of running over the previous five years. Group 1 was comprised of 13 individuals who had not been regularly physically active in the past five years, were without running experience and demonstrated poor physical performance. At the beginning of the programme, none of them was able to manage more than 3 minutes of continuous running. Group 2 consisted of 15 individuals who were recreational runners with running experience up to two years and who had previously independently trained 2 to 3 times a week in order to maintain their physical abilities without professional supervision. Basic group characteristics are described in Table 1.

Table 1: Basic characteristics of a sample (M ± SD)

	Group 1	Group 2	p
N	13	15	
Age (years)	41.7 ± 14.3	38.3 ± 7.8	n. s.
BH (cm)	163.7 ± 3.5	168.4 ± 4.8	*
BM (kg)	70.1 ± 8.0	60.7 ± 4.7	***
BMI	26.8 ± 3.4	21.5 ± 1.7	***
FM (%)	26.6 ± 3.7	20.3 ± 2.9	***
VO2max (ml/min)	2423 ± 428	2527 ± 371	n. s.
VO2max (ml/kg/min)	34,3 ± 5,9	41,7 ± 6,0	**

***p<0.001, **p<0.01, *p<0.05; p – statistical significance between groups, n. s. – statistical non-significant, BH – body height, BM – body mass, BMI – body mass index, FM – fat mass, VO_2max – maximal oxygen consumption

Experimental procedure

The objectives of the training programme, which was adapted to the specific requirements and needs of the runners in each group, were aimed at improving the abilities of runners and preparing them to compete in either the 10 km or 21 km International Ljubljana Marathon. Before inclusion in the training programme, the participants went to see a sports physician who performed anthropometric measurements and measurements of functional and biochemical parameters using stress tests on a treadmill. The same measurements were performed 7-10 days after completing the programme.

Based on the initial results of the stress test, a six-month training programme was prepared for each participant, in which we considered the guidelines of periodisation development for endurance and muscular strength. It was divided into a period of basic training and a period of specific preparation for participation for the race. Training was held four times a week from 90 to 120 minutes. Training sessions were conducted twice a week under the guidance of qualified coaches; however, individual programmes also included a runner's individual or other aerobic exercises at home 1 to 2 times a week. All running training was monitored with Polar S400 and S800 heart rate monitors. Each participant carefully filled out her own training diary, which formed a basis for the trainers' supervision of the whole training programme.

Description of training programme

The content, scope and intensity of the recreational training programme were adapted to the specific needs of each group of runners. The most important part consisted of running exercise - exercises to develop aerobic endurance and improving the techniques of running. The programme of Group 1 consisted of a 2 - to 3 - training units of run or walk and run. An important component of the programme was also training for the development of muscular strength and flexibility of all major muscle groups in the range of two exercise units per week. Participants performed 10 to 12 exercises (for five or six muscle groups – for each two series of the same work) in one training unit. They completed one exercise from 30 to 45 seconds or 15 to 25 repetitions. The pause between repetitions lasted between 60 to 90 seconds, with a rest of 2 minutes between sets. Power exercises were carried out in the open using participants' own body weight with elastic bands and without additional loads. Common exercises were completed by ten minutes of stretching of all major muscle groups. In addition to running training, a once-per-week walk up a hill (a short, approximately 40-minute walk) as well as a once-per-week, long, low-intensity mountain or biking trip was included in their regimen.

The training programme for Group 1 included two running/walking training sessions per week during the initial period and three per week during the following period. These training units were comprised of 2-to-3 minute cycles, with alternating walking and talk-running (intensity between 80-85% of HR max) ranging from 30 to 60 minutes. Intervals of walking were progressively reduced and the running intervals were extended so that all participants were able to run for at least 45 minutes without the intermediate walking interval after a 12-week period. In addition to running, a longer, low-intensity mountain or biking trip was carried out once a week.

The training programme for Group 2 consisted of three running units and two training units with additional aerobic exercise content per week. The major part of the run was carried out at an intensity of 75% to 85% of HR max. One exercise unit per week was held in the form of fartlek (interval training) or tempo run with an intensity of 80% to 95% of HR max. Volume and intensity were gradually increased. In addition to running, a walk up a hill (a short, approximately 40-minute walk) and one long mountain or cycling trip was taken once a week. The exercise programme for power and flexibility was very similar to that of Group 1.

Table 2: Exercise programme – a weekly example

	Group 1	Group 2
Monday	30-45 min run and walk (3 min set) 25 min strength exercises 10 min stretching	45-55 min run (6 min/km; 75-85 % HR max) 25 min strength exercises 10 min stretching
Tuesday	Rest	35-35 min continual walk in slope (height difference 300m to 400m); stretching
Wednesday	20-35 min run and walk (2 min set); 20 min of light continual run 25 min strength exercises 10 min stretching	50 min fartlek (75-95 % HR max) 25 min strength exercises 10 min stretching
Thursday	Rest	Rest
Friday	30-45 min run and walk (3 min set) 25 min strength exercises 10 min stretching	50-60 min run (6 min/km; 75-85 % HR max) 25 min strength exercises 10 min stretching
Saturday	120-180 min light intensive cycling or mountain trip (with stops)	120-180 min light intensive cycling or mountain trip (with stops)
Sunday	Rest	Rest

Exercise realization

In 24 weeks, each participant went through 57 to 80 training sessions for running (an average of 2.7 per week) with an average time of 137 minutes of running per week. The total running time was on average 53.5 hours per woman (Table 2). They were active once a week (average 82 min) with other aerobic activity (walking, bicycle). Exercise output, except for a few participants, did not fully achieve the planned volume. The groups varied less than 30 minutes per week over the extent of the whole physical/ sports activity (Table 3).

Table 3: An average weekly extent of exercise realization (EU – exercise Unit)

	Group 1	Group 2
Number of running EU/week	2.43 / 58 / 90% [1] (planned 64 EU)	2.46 / 57 / 85% [1] (planned 67 EU)
Number of EU with other sport content /week	0.9 / 22 / 78% [1] (planned 28 EU)	1.22 / 28 / 75% [1] (planned 37 EU)
The extent of run/week (min.)	109.5	115.7
The extent of total physical activity /week (min)	201.8	229.5

[1] an average number of EU per week / number of EU in total exercise period / per cent of realized EU in comparison to planned

The experimental procedure was approved by the Ethics Commission of the Faculty of Sport at the University of Ljubljana. The procedure and possible complications were presented to the women in accordance with the Helsinki Declaration. The study was approved by the National Medical Ethics Committee.

Variables and procedure

Measurement of morphological characteristics

Measurement of anthropometric characteristics was carried out in accordance to the instructions of the International Biological Programme – IBP (Weiner & Lourie, 1969). From the measured values we calculated body composition variables: body mass index (BMI), percentage of fat mass (FM) and the percentage of muscle mass (MM), using Matiegka method (Matiegka, 1921). Somatotype was calculated according to the Heath and Carter protocol (Carter & Heath, 1990).

Description of the stress test protocol on the treadmill

A spiro-ergometric parameter, which presents model variables for the assessment of aerobic and anaerobic energy capacity was measured with a stress test on the treadmill. To measure these parameters, we used spiro-ergometric equipment with related software K4 b^2 (Cosmed). For data obtained by the method of Breath-by-Breath during the stress test, the average of the five-second interval was calculated. A protocol was started with ventilation and metabolic parameters monitoring after 1 minute of complete rest. After a warm up (3 min walk at a speed of 5 km/h and 3 min at a speed of 6 km/h at 0% slope), the slope of the treadmill was increased to 2%. Initial running speed was 6 km/h and was increased by 1 km/h every 2 min until exhaustion. For monitoring the reconstruction after the effort, women continued with a 5-minute walk at a speed of 5 km/h.

For the purposes of this study the following variables were selected.

Running endurance variables

test duration (D), running distance in the test on the treadmill (RD), top speed - maximum speed of individuals (vFIN).

Variables of capacity of the cardiovascular system

maximum heart rate (HR max), stroke volume at maximum load (SV max) and minute heart volume at max load (MHV). Stroke volume was calculated by the method of Stringer-Wasserman (Stringer, Hansen & Wasserman, 1997). The calculation was implemented by the computer programme K4 b^2, Cosmed.

Characteristics of respiratory function

breathing frequency (BF), breath volume (BV) and maximum minute ventilation (VE max), VE/VO2 – equivalent for oxygen.

Metabolic variables

the maximum absolute value of oxygen consumption (VO2max), maximum relative value of oxygen consumption (VO2maxR), respiratory quotient (RQ-VCO2/VO2) and maximum levels of blood lactate (LA max).

Somatotype variables

ectomorph, mesomorph and endomorph component (Carter & Heath, 1990).

Data analysis

The data was analysed with the statistical programme SPSS 17.0 for Windows. We used following methods: descriptive statistics to identify differences in individual parameters between the initial and final positions within the group and method of analysis differences for repeated measurements (rANOVA). Differences between groups were analysed using the covariance analysis method (ANCOVA), in which assumptions had been previously tested. The threshold of statistical significance was defined at 5%. Results are presented as mean ± standard deviation (M ± SD).

RESULTS

The results show that the training programme affected morphological characteristics, runner's endurance and also the aerobic abilities of participants in both groups. In comparison between groups, Group 1 achieved a statistically significant greater improvement in VO2max (ml/min/kg).

The exercise influence on running endurance

The six-month recreational training programme was expected to improve some parameters of running endurance in both groups. The time of the stress test was improved by 18.4% in Group 1 ($p<0.001$) and 5.7% in Group 2. Maximum top speed was similarly increased. Group 1 increased it by 15.8% ($p<0.001$) and group 2 for 7.3% ($p<0.01$). Distance on stress test increased for the highest percentage, namely in Group 1 by 27.3% ($p<0.001$) and in group 2 by 17.1% ($p<0.01$); but better absolute values were preserved by Group 2. Statistically significant changes are mark in Table 4. We expected to make significant progress within Group 1 because of a lower initial fitness level, which has already been found by Cunningham and Hill (1975).

Table 4: Comparison of differences between groups by initial and final testing (M ± SD)

	Group 1			Group 2			p
	Before	After	Change (%)	Before	After	Change (%)	
D (s)	867 ± 132	1025 ± 159	18.4 ±7.2***	1012 ± 119	1054 ± 132	5.7 ± 19.9	n. s.
RD (m)	1636 ± 349	2080 ± 488	27.3 ± 12.2***	2106 ± 269	2438 ± 270	17.1 ± 16.7**	n. s.
v FIN (km/h)	9.6 ± 1.24	11.08 ± 1.34	15.8 ± 7.9***	11.3 ± 1.0	12.1 ± 0.6	7.3 ± 7.8**	n. s.

****p<0.001, **p<0.01; p – statistical significance between groups, n. s. – non significant, D (s) – test duration, RD (m) – running distance, v FIN (km/h) – max test speed*

Exercise influence on morphological characteristics

The six-month training programme also affected the morphological characteristics of participants. Individual somatotype components, calculated by Heath and Carter protocol (Carter & Heath, 1990), reflecting changes in the direction of increasing ectomorphy and reducing the endomorph component, which decreased in Group 1 to a statistically significant extent ($p<0.05$). All changes in somatotype components were shown on changing of anthropometric characteristics under the influence of exercise (Table 5). Mesomorph components retained their values with the exception of the minimal reduction in Group 1.

Table 5: Changes in somatotype component (M ± SD)

		Ectomorph component	Mesomorph component	Endomorph component
Group 1	Before	0.6 ± 1.5	5.8 ± 1.4	5.2 ± 1.0
	After	1.0 ± 1.1	5.8 ± 1.3	4.8 ± 0.7*
Group 2	Before	2.8 ± 1.0	3.8 ± 1.2	3.2 ± 0.8
	After	2.9 ± 1.0	3.8 ± 1.1	3.1 ± 0.8

**p<0.05*

The participants experienced significantly altered body composition after the six-month exercise period. Both groups reduced their body weight – an average of 1.9% in Group 1 and 0.9% in Group 2 (Table 6). Weight reduction resulted in a reduction of fat mass ($p<0.05$ in Group 1); the proportion of muscle mass correspondingly increased in both groups. Average body mass index was reduced by 1% in Group 2 and by 3.1% in Group 1, which is also statistically significant at $p<0.01$.

Table 6: Changes in basic morphological characteristics (M ± SD)

	Group 1			Group 2			p
	Before	After	Change (%)	Before	After	Change (%)	
BM	70.1±8.0	68.6±5.9	-1.9±3.7	60.7±4.7	60.1±4.0	-0.9±2.3	n. s.
FM %	26.6±3.7	24.9±2.6	-5.6±5.4**	20.3±2.9	19.8±2.7	-2.2±6.0	n. s.
MM %	40.4±3.7	42.7±2.7	6.7±13.1	42.4±5.3	43.5±1.6	4.7±19.6	n. s.
BMI	26.8±3.4	25.9±2.7	-3.1±4.0*	21.5±1.7	21.2±1.6	-1.0±2.1	n. s.

***p<0.01; *p<0.05; p – statistical significance between groups, n. s. – non significant, BM – body mass, FM % – fat mass, MM % – muscle mass, BMI – body mass index*

Exercise influence on aerobic abilities

Table 7 shows differences in some respiratory parameters, the parameters of cardiac function and metabolic indicators during the initial and final state and a comparison between Group 1 and Group 2. After the six-month period of exercise, the participants improved the absolute value of VO2max (ml/min) by 15.3% in Group 1 and by 4.4% in Group 2 and the relative value of VO2max (ml/kg/min) by 17.9% in Group 1 and by 5.6% in Group 2. All changes are statistically significant. Maximum minute ventilation (VEmax) went up for 20.1% of the women in Group 1 ($p<0.05$) and only 5.1% in Group 2. The increase in VE in Group 1 is result of an increase both in the volume of breath and breathing frequency, as both parameters increased.

Table 7: Changes in physiological and biochemical parameters at maximal effort during initial and final state

	Group 1			Group 2			p
	Before	After	Change (%)	Before	After	Change (%)	
VO2maxR (ml/kg/min)	34.3±5.9	39.8±5.1	17.9±13.8***	41.7±6.0	43.7±4.7	5.6±12.5**	n. s.
VO2maxA (ml/min)	2423±428	2763±392	15.3±12.1***	2527±371	2618±310	4.4±11.0**	*
VE (l)	81.6±14.3	96.3±12.8	20.1±19.4*	85.0±17.0	86.6±13.4	5.1±22.5	n. s.
BV (l)	1.97±0.43	2.15±0.35	10.7±15.1**	1.90±0.4	1.94±0.4	3.1±15.5***	n. s.
BF (b/min)	42.6±8.6	47.6±6.2	17.1±35.5	45.3±6.8	45.8±7.9	2.4±18.8	n. s.
VE/VO2	34.8±4.8	34.0±4.0	-1.7±10.4*	32.3±4.3	31.9±3.7	-1.1±15.9	n. s.
RQ	0.95±0.09	1.05±0.1	11.1±12.4	0.97±0.11	1.02±0.08	6.1±15.2	n. s.
LA max (mmol/l)	6.1±2.2	6.6±1.9	13.3±30.6*	6.3±2.0	7.0±1.0	21.4±44.3	n. s.
HR max (beat/min)	169±10.9	175±14.3	3.1±5.8*	177±9.3	175±10.1	-0.8±6.0	n. s.

HBV max (ml/beat)	85.2±13.8	95.1±12.6	13.0±15.9*	87.6±10.8	91.9±12.5	5.2±10.3**	n. s.
MHV (l/min)	14.6±2.5	16.8±2.9	16.1±13.6***	15.4±2.0	16.1±1.7	5.3±12.3	n. s.

****p<0.001, **p<0.01,*p<0,05; p – statistical significance of difference between groups. n. s. – non significant , VO_2max – maximal oxygen consumption (R – relative, A – absolute), VE – maximal minute ventilation, BV – breath volume, BF – breathing frequency, VE/VO_2 – equivalent for oxygen, RQ – respiratory quotient, LA max – maximal value of lactate, HR max – maximal heart rate, HBV max – maximal heartbeat volume, MHV – minute heart volume*

In Group 1, the exercise programme also caused a 1.7% decrease in the ventilation equivalent for oxygen – VE/VO2 (p <0.05) and an increase in lactate levels between the maximum effort for 13.3% (p <0.05). Parameters did not change significantly in Group 2. Respiratory quotient increased by a statistically nonsignificant amount in both groups. Under the influence of the training programme, some parameters of cardiac function in Group 2 and all in Group 1 changed significantly. Minute heart volume (MHV) increased by a statistically significant amount (p <0.001) at maximum load of 16.1% in Group 1, owing to increase of heart rate, but mostly because of an increase in maximal heartbeat volume, since this increased by as much as 13%. Because of increasing HBV, MHV in Group 1 also increased, despite heartbeat frequency having decreased.

DISCUSSION

Endurance of long-term loads is largely dependent on the efficiency of aerobic metabolic processes. These provide cells with energy for work and for long-term performance of exercise at a level of intensity close to VO2max. Improving the aerobic capacity of humans depends on many factors: in addition to type of exercise, intensity and extent it also involves the physical condition and age of subjects (Fitzgerald, Tanaka, Tran & Seals, 1997; Mamen & Martins, 2010). Exercise caused a higher relative progress in Group 1; in VO2max (ml/kg) parameter participants from Group 1 exceeded values from Group 2.

Running progress was largely due to improvement of aerobic capacity. The duration of the test was extended to almost the same percentage as the relative improvement in oxygen consumption in both groups (18.4% improvement in test duration and increase in relative VO2max for 17.9% in Group 1 and 5.7% improvement in duration of test and the rise in the relative oxygen consumption for 5.6% in Group 2). In parameters of the stress test duration and the achievement of the final velocity, a statistically greater relative percentage of progress was achieved by Group 1. A result of the maximum minute ventilation progress matched the largest relative increases in oxygen consumption and prolonged the duration of the stress test on treadmill. The distance test was statistically significantly increased by 17% for Group 1 and by 27% for Group 2. Progress was the outcome of cardiovascular and respiratory capacity improvement.

The content of lactate in the blood is dependent on its production and consumption. The value tells us how and with what intensity work is done (Astrand & Rodahl, 1986). The content of lactate in the blood at maximum stress on a load test; after six-months of exercise, it had significantly increased (by 13.3% in Group 1 and 21.4% in Group 2). Achieving a higher final speed and longer distance on the stress test also made improvements in the glycolytic function possible. It can be concluded that lactate anaerobic ability of participants improved, due to more intense exercise sessions. It appears that both two groups were exposed to a level of effort that raised their anaerobic capacity.

Because of differences in basic physical condition between Groups 1 and 2, the different progress in improving cardiovascular and respiratory capacity was expected. Greater improvements in aerobic capacity can be expected in people who have lower levels of initial values; this has already been stated by Cunningham and Hill (1975). After 9 weeks of aerobic training, previously inactive participants found their VO2max increased by an average of 34%; after a further 52 weeks, the increase was only 5%. They also found that aerobic exercise first causes central adaptation of the organism, especially cardiac and respiratory function. From this fact they concluded that women with low fitness levels (VO2max less than 28 ml/kg/min) respond on the aerobic load initially by a central adaptation of the organism; after a longer period of exercise, this is followed by a significant adaptation of peripheral factors. The ability to reach maximum oxygen consumption decreases with age. Nevertheless, Group 1, which is not older by a statistically significant amount, increased oxygen consumption significantly in comparison to Group 2. The fact is that, by means of exercise interventions, we can influence the maintenance and even increase of VO2max, which significantly decreases with age in physically inactive individuals (Fitzgerald et al., 1997).

A six-month training programme was also able to bring about a significant change in the physical characteristics of individuals. A higher degree of overall progress, as in the other parameters, occurred in Group 1. Total body weight decreased in both groups; Group 1 also significantly decreased its average fat percentage (5.6%). Seiler et al (1998) established that there exists a more than 25% significant difference in muscle strength between trained and untrained men; a difference which rapidly increases over the years. Changes in morphological features are also reflected in changes in individual somatotype components. Group 1 statistically significantly reduced the average endomorph component of its members. A high endomorph component value is an indicator of heart failure, diabetes, cardiovascular and many other diseases (Heyward & Wagner, 2004, Carter & Heath, 1990). Both groups maintained mesomorph component at the same value, which, despite decrease of total body weight, reflects maintenance of muscle mass. The values of somatotype components show that the anthropometric status of Group 1 significantly improved in the direction of reduced likelihood for various illnesses and a better optimisation of physical performance. In our study we did not monitor food intake – something that it would be reasonable to do in the future in order to obtain a better result interpretation. Many functional changes that are the consequences of ageing, correspond to the consequences of physical inactivity. The results confirm the necessity of regular physical activity – not only in order to avoid the negative effects of aging, but also to counter a decline in functional abilities as a result of physical inactivity.

The training programme was carried out for six months. Regretfully, we could not monitor the parameters during the programme, which would be certainly have been beneficial to assist with further interpretation of the effects of the exercise. Significant changes in Group 1 were partially expected; however, surprises were found in the changes in the VO2max parameter, in which Group 1 achieved a statistically significant better absolute value. These results may also result in greater intrinsic motivation, more consistent implementation of the proposed programme and greater willingness to work. Detailed analysis of the diaries of the participants will provide us with more insights into this part of the background, which can significantly affect the final results.

CONCLUSION

The results show that a six-month recreational training programme, consisting of running workouts and strength and flexibility training, caused a marked improvement of the cardiovascular and respiratory system and an improvement in the value of VO2max. The World Health Organization recommends at least 30 minutes of daily physical activity and our study shows what results may be achieved if the exercise is regular and professionally designed. A similar training programme, in spite of different initial values in two groups, caused an improvement of all indicators of the cardiovascular and respiratory functions and consequently on running abilities. The results show that with training interventions individuals can, despite earlier physical inactivity, greatly improve their physical performance as well as significantly alter their body composition. Regular daily exercise can also improve the abilities of already active women. With the changes in morphological characteristics and aerobic abilities, individuals are able to improve their overall functional capacity and significantly reduce their susceptibility for many diseases. This has a significant impact on maintaining and improving overall health and well-being.

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REWIEWS / POROČILA, 197–208

7TH INTERNATIONAL SYMPOSIUM A CHILD IN MOTION

Koper, Slovenia, October 5th-7th 2012

The already traditional international scientific and expert symposium A Child in Motion, which was organised by the Institute for Kinesiology Research, Scientific Research Centre, University of Primorska and co-organised by the Faculty of Education, University of Primorska and the Faculty of Education, University of Ljubljana, was intended for anyone working in the field of physical/sports activity and for those who incorporate physical/sports activity in their work with children and adolescents.

This year's symposium titled *A Child in Motion for Healthy Aging* was focused on the search of links between children's motor development in the early stages of life and its sustainable impact on healthy growth and quality aging.

In the year dedicated to active aging (European Year for Active Ageing and Solidarity Between Generations - 2012), the symposium has significantly contributed to raising awareness of the importance of motor skills and movement habits acquired in childhood for maintaining good health in later developmental stages and achieving a high quality of life in late adulthood.

The symposium with international participation has offered a wide range of contributions, in the form of plenary lectures, poster and oral presentations, organized in various sections.

The highlighted topics were discussed from different perspectives, indicating the need for an interdisciplinary approach.

Contributions were published in peer-reviewed symposium proceeding book.

Petra Dolenc, PhD

REWIEWS / POROČILA, 197–208

7. MEDNARODNI SIMPOZIJ OTROK V GIBANJU

Koper, Slovenija, 5.–7. oktober 2012

Že tradicionalni mednarodni znanstveni in strokovni simpozij Otrok v gibanju, ki je potekal v organizaciji Inštituta za kineziološke raziskave Znanstveno-raziskovalnega središča Univerze na Primorskem ter v soorganizaciji Pedagoške fakultete Univerze na Primorskem in Pedagoške fakultete Univerze v Ljubljani, je bil namenjen vsem, ki delujejo na področju gibalne/športne aktivnosti ali vključujejo vsebine gibalne/športne aktivnost pri delu z otroki in mladostniki. Naslov letošnjega simpozija se je glasil *Otrok v gibanju za zdravo staranje* s ciljem opozoriti na pomembne povezave med dogajanjem v gibalnem razvoju otroka in trajnostnim vplivom, ki ga ima le-ta na kakovostno in zadovoljno staranje. V letu, posvečenem aktivnemu staranju (European Year for Active Ageing and Solidarity between Generations – 2012), je simpozij pomembno prispeval k ozaveščanju pomena v otroštvu pridobljenih gibalnih kompetenc in gibalnih navad za ohranjanje zdravja v kasnejših razvojnih obdobjih in doseganje kakovosti življenja v pozni odraslosti.

Na simpoziju z mednarodno udeležbo je bilo po sekcijah predstavljenih 44 prispevkov v obliki plenarnih predavanj, posterjev in referatov. Udeleženci so obravnavano tematiko osvetlili z različnih strokovnih vidikov, kar kaže na potrebo po interdisciplinarnem pristopu.

Prispevki so bili objavljeni v recenziranem zborniku simpozija.

dr. Petra Dolenc

THE CREATION OF A NETWORK OF PROFESSIONAL INSTITUTIONS PARTICIPATING IN THE FIGHT AGAINST METABOLIC SYNDROME

Masaryk University, Faculty of Sports Studies, Department of Health Promotion invited the Institute for Kinesiology Research of the University of Primorska, Science and Research Centre to join them in a project funded by European Social Fund in the Czech Republic entitled Metabolic Syndrome: The Creation of a Network of Professional Institutions Participating in the Fight against Metabolic Syndrome. The collaboration was made official with the signing of a contract between the Universities, and began with a visit by Dr. Jitka Kopřivová in Koper in Spring, 2012. Dr. Nina Mohorko visited Brno in November, 2012, where I gave a lecture titled The Rhythms of Our World at a workshop for PhD students. The lecture presented the desynchronisation of circadian rhythms due to modern lifestyles as a possible contributor to metabolic syndrome epidemics. The other lecturers were Dr. Martin Matoulek, Dr. Erik Sigmund, Dr. Iva Hrnčiříková, Dr. Lenka Beránková, from the Czech Republic, and Dr. Milan Luliak, from the Republic of Slovakia. Their topics were exercise for persons with metabolic syndrome, and obesity from a nutritional and inactivity perspective in children and adults. As part of the project, Nina Mohorko also gave a lecture to undergraduate students in physiotherapy called Metabolic Syndrome and Contemporary Lifestyles, where I emphasized the Western diet and its effects on metabolic regulation. The next step in the collaboration will be an internship at the University of Primorska for 2 PhD students from the Masaryk University of Brno at the beginning of 2013.

Nina Mohorko, PhD

METABOLICKÝ SYNDROM

IZGRADNJA MREŽE INSTITUCIJ, KI SODELUJEJO V BOJU PROTI PRESNOVNEMU SINDROMU

Masarykova univerza v Brnu je povabila Inštitut za kineziološke raziskave UP ZRS k sodelovanju pri projektu grajenja mreže inštitucij, ki sodelujejo v boju proti presnovnemu sindromu. Gre za projekt Evropskega socialnega sklada Republike Češke Presnovni sindrom. Univerza na Primorskem je tako podpisala sporazum o sodelovanju z Masarykovo univerzo v Brnu, sodelovanje pa se je udejanjilo s spomladanskim obiskom prof. dr. Jitke Kopřivove v Kopru in z jesenskim obiskom dr. Nine Mohorko v Brnu. Nina Mohorko sem v Brnu sodelovala na delavnici za doktorske študente s predavanjem *The rhythms of our world*, kjer sem predstavila vpliv desinhronizacije cirkadianih ritmov, ki so posledica sodobnega načina življenja, na nastanek presnovnega sindroma. Na delavnici so predavali še dr. Martin Matoulek, dr. Erik Sigmund, dr. Iva Hrnčiříková, dr. Lenka Beránková s Češke in dr. Milan Luliak s Slovaške, ki so predavali o vadbi oseb s presnovnim sindromom in o debelosti, tako v povezavi s prehrano kot pomanjkanjem gibanja pri otrocih in odraslih. V sklopu projekta sem Nina Mohorko predavala tudi študentom fizioterapije, in sicer o presnovnem sindromu v povezavi s sodobnim življenjskim slogom s poudarkom na zahodnjaškem prehranjevanju in z njim povezanimi zapleti v presnovi. Sodelovanje se bo nadaljevalo z obiskom dveh doktorskih študentov z Masarykove univerze na Univerzi na Primorskem v začetku leta 2013.

dr. Nina Mohorko

presentation of research project

PANGeA: PHYSICAL ACTIVITY AND NUTRITION FOR GREAT AGEING

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ABSTRACT

The global problem of ageing is one of the most significant issues of modern society. With this issue arise the challenges of searching for healthy ageing criteria, which will enable individuals to enjoy a high quality of life and be independent in their old age. Research has already shown that the process and consequences of ageing have a strong correlation with lifestyle, but the criteria according to which ageing can be seen as healthy have not yet been defined. The Institute of Kinesiology Research of the Science and Research Centre of the University of Primorska decided to explore and study ageing criteria together with local and foreign partners in the Cross-border Cooperation Programme Slovenia – Italy 2007-2013 PANGeA: Physical Activity and Nutrition for Great Ageing. The project partners are now in the process of preparing the measurements for the study of the situation of the older population in the project area. By interpreting the characteristics of healthy and active elderly people, we will try to define the criteria of healthy ageing. The knowledge will then be applied in practice working with target groups with the cooperation of public institutions from participating regions that are active in the field of assuring the quality of life for the older population.

Keywords: *health, ageing, physical activity, nutrition*

INTRODUCTION

The European population is ageing (Lutz et al., 2008). The proportion of those aged over 65 years in the population of the border regions between Slovenia and Italy is relatively high (18-20%). This diverse population includes many people whose general level of fitness, due to their participation in motor/sports activities, is such that a 75-year-old of today can be compared with a 55-year-old thirty years ago. On the other hand, there are also many individuals suffering from chronic diseases and weak musculoskeletal systems, for which it could also be said that that they have aged prematurely. Research has many times demonstrated a strong correlation between lifestyle and the process and consequences of ageing. However, criteria by which healthy ageing can be assessed have not yet been defined. The global problem of ageing and the challenges involved in the search for healthy ageing criteria, according to which individuals can be assessed as enjoying a high quality of life and as being independent in their old age, have become among the most significant problems of contemporary society. In this connection, the European Commission has declared 2012 to be the Year for Active Ageing and Solidarity between Generations.

A few years before the EU decided to devote such an degree of attention to this issue, the Institute of Kinesiology Research of the Science and Research Centre of the University of Primorska decided to explore and study ageing criteria together with local and foreign partners in order to be able to offer society all possible controls that would enable them to develop an approach to this issue based on specific findings and knowledge. Numerous scientific findings prove the exceptional efficiency of motor function enhancement activities and healthy nutrition in reducing health risks and enhancing the independence of the lives of older members of society. Appropriate information and notifying the public, which involves the cooperation of different organisations, can positively influence the quality of life of the older population. The Cross-border Cooperation Slovenia – Italy 2007-2013 Programme – PANGeA unites public institutions from participating regions that are active in the field of assuring the quality of life of older populations with universities, hospitals, municipalities and the Health Protection Institute of the Republic of Slovenia. The carrying out of promotional and educational programmes as well as the facilitation of direct physical activities will enable us to practically apply lifestyle knowledge that improves the quality of life of target groups of older citizens. We shall use the network of existing healthcare (hospitals), social (elderly homes) and private (fitness centres) organisations, which operate in the areas that are the subject of this project. The fitness programmes health/nutrition measures for the elderly that we will apply should contribute to generally improved health conditions as well as reducing the risks of acute injuries and chronic diseases. At the same time, we will study the effects of permanent inactivity and develop programmes for a more efficient/faster regeneration of motor functions such as gaining independence after hip operations, which have become one of the most frequently occurring problems that the elderly have to cope with.

The activities of the project will strive to improve the current low level of coordination between healthcare and other public institutions. Prior to providing information to the public, project partners will study the situation of the older population in the project area. By interpreting the characteristics of healthy and active elderly people, they will try to define the criteria according to which healthy ageing may be assessed. The activities involving the accumulation of normative values and the implementation of intervention programmes, which will be implemented within the scope of the project, will be based on organisational, promotional, scientific research and subject-related integration of all project partners and other stakeholders. In this way we will establish a permanent relational organisational network bringing together universities, hospitals, municipal care homes, private persons, pensioners' organisations etc.), which will enable further improvements in the health and quality of life of the population living in the border area.

OBJECTIVES OF THE PROJECT

General objectives of the project

- Define healthy ageing factors;
- Set up content-related and HR bases of the international excellence centre (SLO-ITA) in the field of gerontological health;
- Raise awareness on the significance of healthy ageing, social inclusion and mobility of less privileged populations (the elderly);
- Reduce costs of providing healthcare;
- Connect the existing healthcare, social and private entities and improve their mutual coordination.

The programme area includes institutes and universities that have achieved excellent results at an international level, namely in the field of medicine, space physiology, kinesiology, nutrition studies and health in general. It is well known that many different fields of work can complement each other when they are discussed jointly. Our work will be based on merging cross-border bodies of knowledge, translating information and developing technologies that are proven efficient instruments, this being the priority of numerous European programmes. We are aware of the fact that health models as well as exercise and nutrition programmes are out-dated and, as the results of modern lifestyle studies show, also inefficient. Many experiences in research including the simulation of ageing (bed rest studies) and healthy ageing simulation (sportsmen – the elderly) have enabled us to acquire many findings that can be applied in healthcare centres, rehabilitation centres, elderly homes, fitness and wellness centres, sports clubs and, last but not least, for every individual. Despite this, the PANGeA project will need to answer some other scientific questions that refer to the impact of motor function inactivity on the elderly and consequently on their health. Applications that will be provided by the general objectives are as follows:

- Programmes for minimised and optimised motor function/sports activities for the elderly;
- Defining of efficient procedures of data collection concerning the health of different target populations with different pathological conditions;
- Updating of rehabilitation plans for faster recuperation after surgeries of acute and chronic injuries of the hip joint;
- Food programmes for hindering catabolic processes that occur with motor inactivity;
- Establishment of motor function enhancing health parks for the elderly.

Operative objectives of the project

- Setting up of a mobile health laboratory with measuring equipment and qualified measurers;
- Setting up of a web portal providing a graphic interface, database, reporting and information about the health of inhabitants (in Slovene, Italian and English languages);
- 1,000 measurements of health factors of people from the entire programme area including simultaneous promotion campaigns;
- Adjustment and redefinition of health factors transferred from youngsters to the elderly by considering environmental factors;
- Organisation of 20 free training seminars for training fitness trainers for the elderly, 12 free demonstration meetings for fitness programmes for the elderly, performed at their homes, both equally distributed in all six regions;
- Organisation of six scientific meetings, intended as a means of strengthening the project consortium.

Operational objectives are defined in accordance with the achievement of general project objectives. We will work in order to enhance the quality of life of inhabitants from the programme area, as well as on a more global level. Promoting and encouraging health, health monitoring, healthcare measures and preventive measures are the key mechanisms that will enable a coordinated development of health and social life in the programme region. Less privileged groups present a large part of the entire population, which is increasing every year. Our preliminary local projects have resulted in many findings that will acquire a new dimension when we are able to connect these findings via a consortium.

The project has been drafted in the sense of the establishment of healthy ageing criteria, based on connecting interdisciplinary knowledge and the implementation of mass measurements on the elderly, thus enabling the basis for constructing a permanent network of institutions that will offer healthcare and rehabilitation services in order to stimulate the recovery period. All the factors discussed above are capable of being transferred to the level of national policies, which could enable an increase in the quality of life of the elderly by synergising permanent networks (connections between hospitals and joint functional centres) throughout the entire programme area.

The project also has a research focus, since joint criteria for healthy ageing will be set up by connecting universities and other public research institutions (University of Primorska, University of Trieste, University of Udine and University of Ferrara as well as the Public Health Institute of the Republic of Slovenia, Izola General Hospital and Valdoltra Orthopaedic Hospital) based on interdisciplinary and international knowledge. The transfer of knowledge will be assured with the collaboration with the included municipalities of the border area (Municipalities of Koper, Ljubljana, Kranj, Trieste and Ferrara). Furthermore, by introducing intervention programmes, we shall contribute to an enhancement of the quality of life of the elderly, in which physical activity is the core means of social integration.

PANGeA: GIBALNA AKTIVNOST IN PREHRANA ZA KAKOVOSTNO STARANJE

IZVLEČEK

Globalni problem staranja je eden najpomembnejših problemov sodobne družbe. Iz njega izhajajo izzivi za iskanje kriterijev zdravega staranja, ki bodo posamezniku omogočili kakovostno življenje ter neodvisnost in samostojnost v pozni starosti. Raziskave so že dokazale močan vpliv življenjskega sloga na potek in posledice staranja, a kriteriji zdravega staranja pri tem še niso bili definirani. Na Inštitutu za kineziološke raziskave Znanstveno-raziskovalnega središča Univerze na Primorskem smo se odločili, da skupaj z domačimi in tujimi partnerji raziščemo in preučimo kriterije staranja s projektom Programa čezmejnega sodelovanja Slovenija-Italija 2007–2013 – PANGeA: Telesna aktivnost in prehrana za kakovostno staranje. Projektni partnerji smo trenutno v procesu priprav na meritve in preučevanje stanja starejše populacije na projektnem območju. Iz značilnosti zdravih in aktivnih starostnikov bomo razbrali kriterije zdravega staranja. Pridobljena znanja bomo privedli do praktične uporabe ciljnim skupinam v sodelovanju z javnimi ustanovami, ki skrbijo za kakovost bivanja starejše populacije.

Ključne besede: *zdravje, staranje, telesna aktivnost, prehrana*

UVOD

Evropska populacija se stara (Lutz et al., 2008). Tudi v obmejnih regijah med Slovenijo in Italijo je visok odstotek (18–20 %) populacije nad 65 letom starosti. Gre za zelo raznoliko populacijo, med katerimi so nekateri gibalno/športno zelo aktivni, tako da lahko današnjega 75-letnika primerjamo s 55-letnikom izpred 30 let, na drugi strani pa so posamezniki, ki jih pestijo kronične bolezni in oslabljen mišično-skeletni sistem, za katere bi lahko rekli, da so se postarali mnogo prezgodaj. V raziskavah je bil že velikokrat dokazan močan vpliv življenjskega sloga na potek in posledice staranja, pri tem pa kriteriji zdravega staranja še niso bili definirani. Globalni problem staranja ter izzivi iskanja kriterijev zdravega staranja, ki bodo posamezniku omogočili kakovostno življenje ter neodvisnost in samostojnost v pozno starost, so postali eden najpomembnejših problemov sodobne družbe. EU komisija je vpričo tega imenovala leto 2012 za Evropsko leto aktivnega staranja in medgeneracijske solidarnosti.

Kar nekaj let, preden se je EU odločila, da tej problematiki nameni tolikšno pozornost, smo se na Inštitutu za kineziološke raziskave Znanstveno-raziskovalnega središča Univerze na Primorskem odločili, da skupaj z domačimi in tujimi partnerji raziščemo in preučimo kriterije staranja ter družbi ponudimo vzvode, da se s problematiko spopade na osnovi konkretnih ugotovitev in dognanj. Številna znanstvena dognanja dokazujejo izjemno učinkovitost gibalne aktivnosti in zdrave prehrane pri zmanjševanju zdravstvenih tveganj in povečanju samostojnosti bivanja starejše populacije. Ustrezno informiranje in poučevanje javnosti, ki zahtevata sodelovanje različnih organizacij, imata lahko pozitivne učinke na kakovost življenja starejše populacije. Projekt programa čezmejnega sodelovanja Slovenija-Italija 2007–2013 – PANGeA združuje javne ustanove iz upravičenih regij, ki skrbijo za kakovost bivanja starejše populacije, od inštitutov, univerz, do bolnišnic, občin in Inštituta za varovanje zdravja RS. S programi promocije, edukacije in neposrednih vadbenih aktivnosti bomo znanja o življenjskem slogu, ki izboljša kakovost bivanja, privedli do praktične uporabe ciljnim skupinam starejših občanov. Pri tem bomo uporabili mrežo obstoječih zdravstvenih (bolnišnice), socialnih (domovi za starejše občane) in zasebnih (centri za telesno vadbo) subjektov, katerih temeljna dejavnost sovpada s tistimi, ki jih vključuje projekt. Vadbeni programi za starejše osebe in ukrepi za zdravo prehrano, ki jih bomo uporabili, bodo prispevali k boljšemu splošnemu zdravstvenemu stanju, zmanjševali dovzetnost za nastanek akutnih poškodb in kroničnih obolenj. Na drugi strani bomo preučili učinke trajne neaktivnosti in razvili programe za učinkovitejšo/hitrejšo obnovo gibalnih funkcij in neodvisnosti po operacijah kolka kot enega najbolj perečih problemov starejših oseb.

Projektne aktivnosti bodo tako skušale preseči nizko stopnjo koordinacije med zdravstvenimi in drugimi javnimi ustanovami. Pred samim informiranjem bodo projektni partnerji preučili stanje starejše populacije na projektnem območju in iz značilnosti zdravih in aktivnih starostnikov razbrali kriterije zdravega staranja. Aktivnosti zbiranja normativnih vrednosti in implementacija intervencijskih programov, ki se bodo izvajali v projektu, bodo temeljile na organizacijskem, promocijskem, znanstvenoraziskovalnem in vsebinskem povezovanju vseh projektnih partnerjev ter drugih deležnikov.

S tem bo vzpostavljena trajna organizacijska mreža (univerze-bolnišnice, univerze-občine-domovi za starejše občane, univerze-zasebniki-društva upokojencev itd.), ki bo omogočala nadaljnji razvoj področja zdravja in kakovosti bivanja prebivalstva v čezmejnem območju.

CILJI PROJEKTA

Splošni cilji projekta

- Definicija faktorjev zdravega staranja;
- Postavitev vsebinskih in kadrovskih osnov mednarodnega centra odličnosti (SLO-ITA) na področju zdravja starejših občanov;
- Dvig osveščenosti o pomenu zdravega staranja, socialne vključenosti in mobilnosti depriviligiranih populacij (starostniki);
- Zniževanje stroškov zdravstvene oskrbe;
- Povezovanje obstoječih zdravstvenih, socialnih in zasebnih subjektov in izboljšanje njihove medsebojne koordiniranosti.

Programsko področje vsebuje inštitute in univerze, ki dosegajo mednarodno odmevne rezultate na področju medicine, vesoljske fiziologije, kineziologije, nutricionistike in splošnega zdravja. Znano je, da se naštete področja lahko s skupno obravnavo izjemno dopolnjujejo. Naše delo bo temeljilo na združevanju mejnih znanosti, translaciji znanj in tehnologij, kar predstavlja učinkovit instrument in je s tem prioriteta številnih evropskih programov. Zavedamo se, da so modeli zdravja, programi vadbe in prehrane zastareli in, kot kažejo rezultati modernih študij stanja sodobnega življenjskega sloga, neučinkoviti. Preko bogatih raziskovalnih izkušenj, s simulacijo staranja (študije dolgotrajnega ležanja) in s simulacijo zdravega staranja (športniki - starostniki), smo pridobili številna spoznanja, ki so pripravljena na aplikacije v zdravstvene domove, rehabilitacijske centre, domove za ostarele, fitness in wellness centre, športne klube oziroma kar vsakemu slehernemu posamezniku. Kljub temu pa bo potrebno s projektom PANGeA odgovoriti še na nekatera znanstvena vprašanja, ki se nanašajo na vpliv gibalne neaktivnosti na starostnike in s tem na njihovo zdravje. Aplikacije, ki jih bodo zagotavljali splošni cilji, so naslednje:

- Izdelani programi za minimalno in optimalno gibalno/športno aktivnost starostnikov;
- Definirani učinkoviti postopki zbiranja podatkov zdravja različnih ciljnih populacij oziroma populacij različnih patoloških stanj;
- Prenovljeni rehabilitacijski plani za hitrejše okrevanje po operativnih posegih akutnih in kroničnih poškodb kolčnega sklepa;
- Prehrambeni programi za zaviranje katabolnih procesov ob gibalni neaktivnosti;
- Izdelava gibalnih parkov zdravja za starejše.

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Operativni cilji projekta

- Postavitev mobilnega laboratorija zdravja z merilno opremo in usposobljenimi merilci;
- Postavitev spletnega portala (grafični vmesnik, podatkovna baza, portal poročanja in obveščanja) zdravja prebivalcev (v slovenščini, italijanščini in angleščini);
- Opravljenih 1000 meritev faktorjev zdravja ljudi s celotnega programskega območja, s sočasnimi promocijskimi akcijami;
- Prilagoditev in redefinicija faktorjev zdravja iz mladostnikov na starostnike z upoštevanjem okoljskih faktorjev;
- Organizacija 20 brezplačnih izobraževalnih seminarjev za usposabljanje vodij vadbe za starejše ter 12 brezplačnih demonstracijskih srečanj za vadbene programe starostnikov na domu, oboje enakomerno razporejeno po vseh šestih regijah;
- Organizacija šestih znanstvenih sestankov, namenjenih krepitvi konzorcija projekta.

Operativni cilji so definirani v skladu z doseganjem splošnih ciljev projekta. Delovali bomo v smeri povečanja kakovosti življenja prebivalcev programskega območja, pa tudi bolj globalno. Promocija in spodbujanje zdravja, spremljanje zdravja, zdravstveno ukrepanje in preventivno delovanje so ključni mehanizmi, ki bodo programski regiji omogočali koordiniran razvoj zdravstvenega in socialnega življenja. Depreviligirane skupine predstavljajo velik del celotne populacije, ki se vsako leto povečuje. V naših predhodnih lokalnih projektih smo prišli do številnih spoznanj, ki bodo dobila novo dimenzijo, ko jih bomo povezali preko konzorcija.

Projekt je zasnovan v smislu postavljanja kriterijev zdravega staranja, na podlagi povezovanja interdisciplinarnih znanj in izvedbe množičnih meritev na starostnikih, kar bo zagotavljalo osnovo za izgradnjo trajne mreže institucij, ki bo nudila zdravstveno-rehabilitacijske storitve v podporo hitrejšemu okrevanju. Vse to je mogoče prenesti na nivo nacionalnih politik, ki bi s sinergijo trajnih mrež (povezave med bolnišnicami in skupnimi funkcionalnimi centri) na celotnem programskem območju omogočile dvig kakovosti življenja starostnikov.

Projekt je tudi raziskovalno usmerjen, saj se bodo s povezovanjem univerz in drugih javnih raziskovalnih inštitucij (Univerze na Primorskem, Univerze v Trstu, Univerze v Vidmu in Univerze v Ferrari ter Inštituta za varovanje zdravja RS, Splošne bolnišnice Izola in Ortopedske bolnišnice Valdoltra) na podlagi interdisciplinarnih ter mednacionalnih znanj postavljali skupni kriteriji zdravega staranja in ugotovitve bodo prenesene v neposredno prakso v sodelovanju z lokalno skupnostjo (Mestne občine Koper, Ljubljana, Kranj ter Trst in Ferrara). Nadalje pa bomo preko uvedbe intervencijskih programov prispevali k dvigu kakovosti življenja starejših oseb, pri čemer je telesna aktivnost osrednje sredstvo socialne integracije.

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A LARGE HUMAN CENTRIFUGE FOR EXPLORATION AND EXPLOITATION RESEARCH

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