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# Health Fitness – Truth or Marketing

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***Abstract:*** *Numerous scientific studies have shown that physical activity has a positive effect on the health of modern people. Exercise for health is one of the main contents on which the promotion of fitness is based. The fitness industry rapidly develops and creates more and more money. The term health fitness is often misused because of the increased profit. In practice, there are more and more programs that have the prefix health, but they are essentially classic marketing. The aim of this paper is to point out to the incorrect and uncritical interpretation of health fitness. There are three examples that illustrate the ability to manipulate people who do not understand what health fitness is. Lumbal syndrome (back pain), osteoporosis and action of so-called hormones of happiness were analyzed.*

***Key words:*** *health, fitness, lumbar syndrome, osteoporosis, osteopenia, physical activity, endorphin, serotonin.*

## Introduction

It is difficult to precisely determine a person's health. This fact is supported by WHO (2006) definition, where health is not only linked to the absence of illness, but to the condition of the total physical, mental, and social well-being. Certain later definitions (Taylor &Marandi, 2008; Bellieni&Buonocore, 2009; Huber et al., 2011) also indicate the complexity of the term health, whereby only certain aspects of it are emphasized (bodily functions, metabolic efficiency, absence of pain, the feeling of personal satisfaction, etc.). There is a large number of factors influencing a person's health which are divided into two large groups according to the WHO (2006) documents: endogenous (factors of heritage, genetics) and exogenous (economic factors, socio-cultural determinants, physio-biological environment, etc.). One of the most important exogenous factors of a modern person's health, as well as in scientific and quasi-scientific, program-propaganda, or even political texts - is physical ac-

# Zdravstveni fitnes – istina ili marketing

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***Apstrakt:*** *Brojne naučne studije su dokazale da fizička aktivnost ima pozitivan uticaj na zdravlje savremenog čoveka. Jedan od glavnih sadržaja na kojima se zasniva promocija fitnesa je vežbanje zbog zdravlja. Fitnes industrija se brzo razvija i obrće sve veći novac. Pojam zdravstveni fitnes se često zloupotrebljava zbog povećanja zarade. U praksi je sve više programa koji imaju prefiks zdravstveni, a suštinski su klasičan marketing. Cilj ovog rada je da ukaže na pogrešno i nekritično prihvatanje zdravstvenog fitnesa. Data su tri primera koji ilustruju mogućnost za manipulaciju osobama koje ne razumeju šta je zdravstveni fitnes. Analizirani su: lumbalni sindrom (bol u leđima), osteoporoza i dejstvo takozvanih hormona sreće.*

***Ključne reči:*** *zdravlje, fitnes, lumbalni sindrom, osteoporoza, osteopenija, fizička aktivnost, endorfin, serotonin.*

## Uvod

Zdravlje čoveka teško je precizno odrediti. To pokazuje i definicija WHO (2006) kojom se ono ne vezuje samo za odsustvo bolesti, već za stanje potpunog fizičkog, mentalnog i socijalnog blagostanja. Na kompleksnost pojma zdravlja ukazuju i neke kasnije definiceije (Taylor & Marandi, 2008; Bellieni & Buonocore, 2009; Huber et al., 2011) kojima se u prvi plan ističu samo njegovi pojedini aspekti (telesne funkcije, metabolička efikasnost, odsustvo bola, osećaj lične satisfakcije isl). Na zdravlje ljudi utiče veliki broj faktora koji se u dokumentima WHO (2006) dele u dve velike grupe: endogene (faktori nasleđa, genetike) i egzogene (ekonomski faktori, socio-kulturne determinante, fizičko-biološka sredina itd). Kao jedan od značajnijih egzogenih faktora zdravlja savremenog čoveka, kako u naučnim i kvazi naučnim, tako i u programsko-propagandnim, čak i političkim tekstovima je – fizička aktivnost. Njoj se

tivity. Frequently, the effects are non-critically attributed to it and are difficult to prove and explain.

An objective overview of the impact of physical activity on a person's health is predominantly hindered by non-scientific claims that are being used nowadays as marketing tools. They are used to conduct a non-ethical manipulation by insufficiently informed trainers in various fitness centers and "beauty" studios. This situation is made worse by the pharmacology industry that uses aggressive campaigns to promote various misconceptions in the form of supposed dietary supplements, "fat melters" and similar trick-products. The manufacturers do not need any scientific evidence regarding the real effects of those products, but only a confirmation of a referential state institution that the product is not harmful to health in order to place it into the market, which is overly saturated by uneducated consumers. Taking advantage of such situation (as the old saying goes: if it does not do harm, maybe it will do good), lots of people are getting rich by selling worthless products.

Modern sciences (medicine, kinesiology, psychology …) have recognized the significance of physical activity to the modern person, who, due to speedy development of technology, leads a sedentary way of life and lacks free time, has encountered the problem marked as hypokinesia. There is a large number of scientific evidence regarding the importance of dosed physical activity. However, those are usually partial evidence of stochastic nature, with limited generalization. The importance of physical activity is most often linked with obesity control, correction of child posture, prevention of cardio-vascular diseases, diabetes, and metabolic dysfunctions. In not so rare cases, however, non-critical glorification of physical activity, particularly its uncontrolled application, was the cause of new health problems, even sudden death. Across the world, the term fitness is usually used for health-related exercise with the widest spectrum of activity. Due to large economic (market) potential, fitness has gained the features of an industry. Attracting as high number of exercisers and creating profit are the basic goals of fitness industry. It offers various programs and devices that are not always in accordance with the health needs and abilities of the exerciser. Medical promotion of such programs and devices is primarily used to tap into people's superficial motives, such as good looks. What is being promoted as good (fit) looks very often has nothing to do with health. By using the ignorance of exercisers, many fitness clubs, for example, promote lifting weights in a gym as a weight loss program, which clashes with the initial lessons about energetics of muscular activity. It has been scientifically proven long ago that a human

često nekritički pripisuju i efekti koje je teško dokazati i objasniti.

Objektivno sagledavanje uticaja fizičke aktivnosti na zdravlje ljudi najviše ometaju nenaučne tvrdnje koje se danas koriste kao marketniški alati. Pomoću njih se sprovodi neetična manipulacija nedovoljno informisanim vežbačima u različitim fitnes centrima i studijima „lepote". Situaciju pogoršava i farmakološka industrija koja agresivnim kampanjama promoviše razne zablude u vidu navodnih dijetetskih preparata, „topljača masti" i sličnih trik-proizvoda. Za njihov plasman na aktuelno tržište zasićeno needukovanim korisnicima, proizvođačima uopšte nisu potrebni naučni dokazi o stvarnim efektima tih preparata, već jedino potvrda neke referentne državne ustanove da proizvod nije štetan po zdravlje. Koristeći se takvom situacijom (kao i onom narodnom: ako ne škodi možda će da koristi) mnogi se bogate prodajom bezvrednih proizvoda.

Savremene nauke (medicina, kineziologija, psihologija...) prepoznale su značaj fizičke aktivnosti za savremenog čoveka koji je, zbog ubrzanog razvoja tehnike, sedentarnog načina života i manjka slobodnog vremena, ušao u problem označen kao hipokinezija. O značaju dozirane fizičke aktivnosti postoji veliki broj naučnih dokaza. Obično su to, međutim, parcijalni dokazi, stohastičkog karaktera, sa ograničenom generalizacijom. Značaj fizičke aktivnosti se najčešće dovodi u vezu sa kontrolom gojaznosti, korekcijom dečje posture, prevencijom kardio-vaskularnih bolesti, dijabetesa i metaboličkih disfunkcija. Nisu retki slučajevi, međutim, da su nekritično veličanje fizičke aktivnosti, naročito njena nekontrolisana primena, bili uzrok nastajanja novih zdravstvenih problema, čak i iznenadne smrti. Za zdravstveno vežbanje sa najširim spektrom delovanja u svetu se najviše koristi pojam fitnes. Zbog velikih ekonomskih (tržišnih) potencijala fitnes je poprimio obeležja industrije. Privlačenje što većeg broja vežbača i stvaranje profita osnovni su ciljevi fitnes industrije. Ona nudi raznovrsne programe i sprave koji nisu uvek usklađeni sa zdravstvenim potrebama i mogućnostima vežbača. Medijskom promocijom takvih programa i sprava prvenstveno se deluje na površne motive ljudi, poput dobrog izgleda. Kao dobar (fit) izgled često se promoviše ono što nema mnogo veze sa zdravljem. Koristeći se neznanjem vežbača mnogi fitnes-klubovi, na primer, promovišu dizanje tegova u teretani kao program za mršavljenje, što je u suprotnosti sa početnim lekcijama o energetici mišićne aktivnosti. Odavno je naučno dokazano da ljudski mišić ne koristi masti kao gorivo u radu visokog intenziteta, te da se masti mogu pokrenuti samo u radu srednjeg i niskog intenziteta i

muscle does not use fats as fuel in high-intensity work, and that the fats can be initiated only in medium or low intensity activity, and only under the condition that such activity lasts longer than 24 minutes. Therefore, those are activities such as longer walks, bike riding, moderate jogging, or classic chores (vacuuming the apartment, grass mowing, watering the garden, going to the market, etc.).

Unfortunately, for most modern fitness programs, there is no exact scientific evidence regarding the energy zone in which they take place, nor the objective effects they create. Valorizing fitness programs, particularly those with the ambition of being proclaimed as health fitness, requires complex approach. Apart from precise diagnostics (ergonomic, kinematic and dynamic), it is very important to take into consideration the individual features of the exerciser (sex, age, level of training, type of body constitution, the condition of moving apparatus, the level of anaerobic threshold, values of heart frequency in RQ=0.7 or RQ=1, tendency to be injured, level of positive and negative effective conditions, etc.). There are very few fitness centers or sports medicine clinics that have this information, and without them it is impossible to find the right measure to determine the level which turns fitness activity into either health or marketing means. This paper is written without any ambitions to offer a conclusive answers, but only to use several examples from practice to indicate the thin line separating health fitness from classic marketing manipulation.

***Example 1: Lumbar syndrome***

Lumbar syndrome is a collection of syndromes characterized by acute pain or chronically present pain in the lumbo-sacral part of the spinal column, with a possible cramping of paravertebral muscles and limited movability of the lumbar spine. It occurs equally in persons of both sexes and recidivation is easy to occur. It is one of the most frequent health problems and the most frequent cause of taking leave of absence from work. It is estimated that 80% of adults feel pain in the lumbar part of the spine at least once in their life, which recidivates in at least 50% of the cases (Manusov, 2012). The problem of back pain most frequently occurs in the most productive period of life, between the age of thirty and fifty, equally in both sexes. In the initial phase, this is only an acute spinal disc herniation accompanied by a prolapse of the nucleus pulposus of intervertebral disk into the zone of fibrous ring (Figure 1). In most people, it is accompanied by a decreased ability to work due to unpleasant pain and unnatural body posture (Figure 2). If the proper treatment is applied in time, most patients can recover from discus hernia and only in 5% of

samo pod uslovom da takav rad u kontinuitetu traje duže od 24 minuta. To su, dakle, aktivnosti poput dužih šetnji, vožnje bicikla, umerenog trčanja ili klasičnih kućnih poslova (usisavanje stana, košenje i zalivanje bašte, odlazak na pijac isl.).

Za većinu savremenih fitnes programa, na žalost, ne postoje egzaktni naučni dokazi o energetskoj zoni u kojoj se odvijaju, niti o objektivnim efektima koje ostvaruju. Valorizovanje fitnes programa, naročito onih koji imaju ambicije da budu proglašeni za zdravstveni fitnes, zahteva kompleksan pristup. Osim precizne dijagnostike (kako ergonomske, tako kinematičke i dinamičke), veoma je značajno uvažiti i individualna obeležja vežbača (pol, uzrast, nivo treniranosti, konstitucionalni tip, stanje aparata za kretanje, nivo anaerobnog praga, vrednosti frekvencije srca pri RQ=0,7 ili RQ=1, sklonost ka povređivanju, nivo pozitivnih i negativnih afektinih stanja itd.). Ovim informacijama danas raspolaže malo koji fitnes centar ili ambulanta sportske medicine, a bez njih je nemoguće pronaći pravu meru za određivanje obima i intenziteta fitnes aktivnosti. Problem ovog teksta upravo je traganje za tom merom koja fitnes aktivnost pretvara ili u zdravstveno ili marketinško sredstvo. Napisan je bez ambicija da ponudi konačne odgovore, već da kroz nekoliko primera iz prakse ukaže na tu tanku granicu koja zdravstveni fitnes deli od klasične tržišne manipulacije.

***Primer 1: Lumbalni sindrom***

Lumbalni sindrom je skup simptoma koji se karakterišu akutnim bolovima ili hronično prisutnim bolom u lumbosakralnom delu kičmenog stuba, uz moguću pojavu grča paravertebralne muskulature i ograničenjem pokretljivosti lumbalne kičme. Podjednako je čest kod osoba oba pola i lako recidivira. To je jedan od najučestalijih zdravstvenih problema i najčešći uzrok izostanka s posla. Procenjuje se da 80% odraslih ljudi bar jednom tokom života oseti bol u lumbalnom delu kičme, koji recidivira u najmanje 50% slučajeva (Manusov, 2012). Problem bola u leđima se najviše javlja u najproduktivnijem periodu života, između tridesete i pedesete godine, podjednako često kod oba pola. U početnoj fazi radi se samo o akutnoj diskus herniji koja je praćena prolapsom galerntnog jedra intervertebralnog diskusa u zonu fibroznog prstena (Slika 1). Kod većine je praćena smanjenjem sposobnosti za rad zbog neprijatnog bola i neprirodnog položaja tela (Slika 2). Ukoliko se pravilan tretmann primeni na vreme, od diskus hernije se oporavi većina pacijenata i samo kod 5% slučajeva ovaj bol pređe u hroničnu bolest (Menezes Costa Lda

the cases this pain grows into a chronic illness (Menesez Costa Lda et al., 2012). In the chronic phase, the crack of the fibrous ring deepens and leads to discopathialumbalis, which in time leads to a constant pressure to the surrounding spinal nerves. This local lesion of the spinal nerves is expanded in time and leads to sciatica.

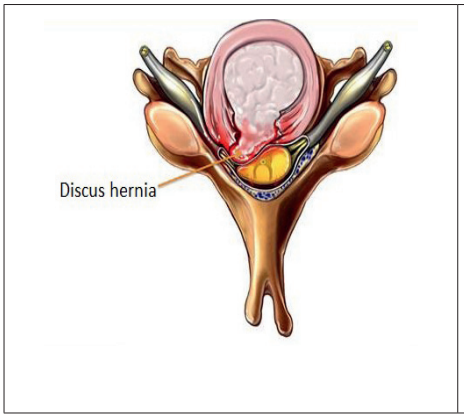
Most people who feel pain in the lumbar spine, usually after long periods of sitting and lifting heavy weights from a deep forward bend without flexing in the knee joint (typical mechanism of origin), see a doctor who recommends them to take physical treatment. Electricity, magnets and other similar physiotherapeutic treatments speed up the recovery process in many patients, but they never remove the main cause of lumbar syndrome, which is - lordosis in lumbar spine. This lordosis is caused by shortening of the main flexor in the hip joint, m. iliopsoas (Figure 3), which is constantly contracting due to all-day sitting, whether during work, driving a car, working at the computer or too long resting position (Hendrick, Milosavljevic& Hale, 2011). According to this, a permanent combat against the initial phase of lumbar syndrome (lordosis and spinal disc herniation) is not a passive physiotherapeutic treatment that only decreases the acute pain, but it includes working on removing the main cause, which is – systematic stretching of m. iliopsoas combined with everyday strengthening of stomach muscles (Qaseem, Wilt, McLean & Forciea, 2017).

The first spinal disc herniation is the last alarm for the patient and a sure sign that they must immediately start with everyday stretching of the flexor in the hip joint and strengthening of stomach muscles. As most people lead a sedentary way of life, it is only logical that there is a high predisposition in all persons for the contracture of m. iliopsoas, lumbar lordosis and finally lumbar syndrome. Ac-

et al., 2012). U hroničnoj fazi produbljuje se pukotina fibroznog prstena i nastupa diskopatija koja vremenom dovodi do konstantnog pritiska na okolne spinalne nerve. Ova lokalna lezija spinalnih nerava vremenom se proširuje i dovodi do ishialgije.

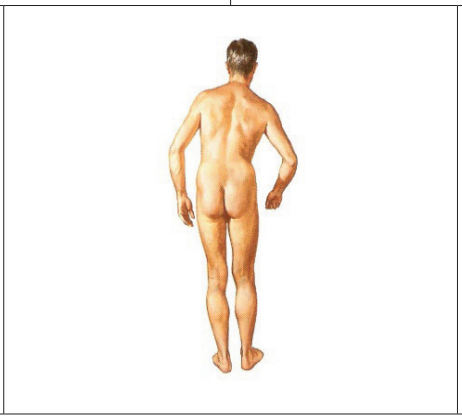
Većina ljudi koja oseti bol u lumbalnoj kičmi, obično nakon dugog sedenja i podizanja teškog tereta iz dubokog pretklona bez fleksije u zglobu kolena (tipičan mehanizam nastanka), odlazi kod lekara koji mu preporučuje fizikalnu terapiju. Struje, magneti i slični fizioterapeutski tretmani kod mnogih pacijenata ubrzaju proces oporavka, ali nikada ne uklone glavni uzrok nastanka lumbalnog sindroma, a to je – pojava lordoze u lumbalnoj kičmi. Ovu lordozu izaziva skraćenje glavnog pregibača u zglobu kuka, *m. iliopsoas*-a (Slika 3) koji je u stalnoj kontrakturi zbog celodnevnog sedenja, bilo zbog posla, vožnje automobila, rada na računaru ili predugog odmarajućeg položaja Hendrick, Milosavljevic & Hale, 2011). Prema tome, trajna borba protiv početne faze lumbalnog sindroma (lordoze i diskus hernije) nije pasivni fizioterapeutski tretman kojim se samo umanjuje akutni bol, već rad na otklanjanju glavnog uzroka, a to je – sistematsko istezanje m. iliopsoas-a kombinovano sa svakodnevnim jačanjem trbušne muskulature (Qaseem, Wilt, McLean & Forciea, 2017).

Prva diskus hernija je poslednji alarm za pacijenta i siguran znak da se odmah mora početi sa svakodnevnim istezanjem pregibača u zglobu kuka i jačanjem trbušne muskulature. Kako većina ljudi danas vodi sedentarni oblik života, logično je da kod svih postoji visoka predisponiranost za kontrakturu m. iliopsoas-a, lumbalnu lordozu i na kraju pojavu lumbalnog sindroma. Prema tome, kod svih takvih osoba




***Slika 1:*** *Prolaps Nucleus pulposus-a kroz anulus fibrosus intervertebralnog diskusa*

***Figure 1:*** *Prolapse of nucleus pulpous through anulusfibrosus of intervertebral disk*



***Slika 2:*** *Tipičan položaj čoveka sa lumbalnim sindromom*

***Figure 2:*** *Typical position of a man with lumbar syndrome*


***Slika 3:*** *Pregibač u zglobu kuka*

***Figure 3:*** *Flexor in the hip joint*

cording to this, with all such persons, health fitness must contain stretching exercises of flexors in hip joint and strengthening of the stomach wall. Such exercises can be done in any place (at home or at work) and they do not require going to a fitness center, much less a gym.

***Example 2: Experiment with exercises and osteopenia***

Osteoporosis is a systemic disease of the skeleton characterized by decreased mineral bone density (Bone mineral density – BMD) and harming of bone tissue microarchitecture (Jordan & Cooper, 2002; See Tai, Parsons, Rutherford &Lliffe, 2009). These changes cause lower bone density and increase the possibility of fracture (Bessette, 2008; NOF, 2012). Osteoporosis is widespread and is gaining epidemic proportions. Currently, there are over 200 million people suffering from osteoporosis, primarily females of older age. After the age of 40, bone mineral density progressively decreases for about 0.5% per year of life, particularly in women (Gomez-Cabello et al., 2012). The prevalence of osteoporosis grows from 4% in women of the age 50-59 to 52% in women over 80. There is a growing trend of osteoporosis fractures. During a person's life, the possibility of these fractures is 50% in women and 25% in men (NOF, 2016). Osteopenia is the initial phase of the physiological aging of the bone leading to osteoporosis. Around the age of 25 the bones achieve maximum density (peak bone mass). After that, the BMD stagnates, and after the menopause it begins do decrease as the resorption speeds up and surpasses bone formation. This leads to osteopenia and it usually occurs in perimenopause, when the BMD in women decreases by about 2%. In post-menopause, BMD decreases by 1-1.5% per year. In the eighth decade of life, women have about 30% lower BMD than in the third decade, thus significantly increasing the risk of fracture (ecker, Lappe, Davies & Heaney, 2000; Wayne, 2012).

The best way to combat early onset of osteopenia is prevention (NOF, 2016). There is a significant link between increased physical activity and BMD. It plays an important role in increasing bone mass in childhood and early adolescence (Obradović et al., 2009). After the age of 35, dosed physical activity significantly contributes to maintaining bone mass, and in older persons it slows its loss and decreases the risk of fracture (Compston et al., 2009). Bone quality achieved through exercise cannot be permanently maintained if the exercise is not regular (WHO, 2016). The evidence for that is bone mass reduction even in younger women occurring as a consequence of immobilization due to injury of the movement apparatus (Rautava, 2007). Sev-

zdravstveni fitnes mora da sadrži vežbe istezanja pregibača u zglobu kuka i jačanje trbušnog zida. Takve vežbe mogu da se izvode na svakom mestu (kod kuće i na poslu) i zbog njih se ne mora u fitnes centar, a kamo li u teretanu.

***Primer 2: Eksperiment sa vežbanjem i osteopenijom***

Osteoporoza je sistematsko oboljenje skeleta koje se karakteriše smanjenjem mineralne gustine kosti (*Bone mineral density* – BMD) i narušavanjem mikroarhitekture koštanog tkiva (Jordan & Cooper, 2002; See Tai, Parsons, Rutherford & Lliffe, 2009). Ove promene uzrokuju manju čvrstinu kosti i povećavaju mogućnost za prelom (Bessette, 2008; NOF, 2012). Osteoporoza je široko rasprostranjena i dobija dimenzije epidemije. Trenutno u svetu od osteoporoze boluje preko 200 miliona osoba, pretežno žene starije životne dobi. Nakon 40-e godine života mineralna gustina kostiju progresivno se smanjuje oko 0,5% po godini života, naročito kod žena (Gomez-Cabello et al., 2012). Prevalenca osteoporoze raste od 4% kod žena sa 50-59 godina do 52% kod žena preko 80 godina. Osteoporotske frakture imaju trend rasta. Tokom života mogućnost nastanka ovih fraktura kod žena iznosi 50%, a kod muškaraca 25% (NOF, 2016). Osteopenija je početna faza fiziološkog starenja kostiju koja sa godinama dovodi do osteoporoze. Oko 25-e godine kosti dostižu maksimalnu gustinu (peak bone mass). Nakon toga BMD stagnira, a od menopauze počinje da se smanjuje jer se resorpcija ubrzava i prevazilazi koštano formiranje. Tako nastaje osteopenija i obično se javlja u perimenopazi kada BMD žena godišnje opada za oko 2%. U postmenopauzi BMD se smanjuje za 1-1,5% godišnje. U osmoj deceniji života žene imaju za oko 30% manji BMD nego u trećoj deceniji čime se značajno povećava rizik za prelom (Recker, Lappe, Davies & Heaney, 2000; Wayne, 2012).

Najbolji način borbe protiv preranog nastanka osteopenije je prevencija (NOF, 2016). Postoji značajna veza između povećane fizičke aktivnosti i BMD. Ona ima važnu ulogu u povećanju koštane mase tokom detinjstva i rane adolescencije (Obradović et al., 2009). Nakon 35-e godine dozirana fizička aktivnost značajno doprinosi održavanju koštane mase, a kod starijih osoba usporava njen gubitak i smanjuje rizik od preloma (Compston et al., 2009). Kvalitet kosti koji se postigao vežbanjem ne može trajno da se održava ukoliko vežbanje nije redovno (WHO, 2016). Dokaz za to je redukcija koštane mase čak i kod mlađih žena koja nastaje kao posledica imobilizacije zbog povreda aparata za kreta-

eral scientific papers indicate a positive influence of systematic physical activity to bone mass (Kohrt et al., 2004; Bošković et al., 2013; Roghani, 2013). On the other hand, physical inactivity (hypokinesia) has a negative impact on bone remodeling and increases resorption (Gupta, et al., 2014). Apart from a direct impact on the bones, hypokinesia lowers muscle power, which influences the lowering of abilities of the locomotor apparatus and increases the risk of falls and fractures (Ye, Wu, & Wu, 2013).

Taking as the starting point the findings of previous studies indicating a positive impact of physical activity on mitigating the consequences of osteopenia, an experiment has been conducted at the Faculty of Sports and Tourism in Novi Sad including 26 women in post-menopause of age between 46 and 58, in whom osteopenia has been diagnosed using DXA method. The sample was divided into 2 groups – experimental and control. In the experimental group a combined program of exercise had been applied, consisting of aerobic activities and strength exercises, while the control group did not do any exercise. The program had lasted for 7 weeks, with 3 trainings per week and a break day between them. The intensity of aerobic training was between 60% and 70% of heart reserve, and strength training intensity was between 60% and 85% of one repetitive maximum (1RM). Before and after the experiment the following has been recorded: the level of biochemical markers in serum (Beta-CTx, tP1NP and ALP isoenzyme), biochemical parameters of building, 1RM of leg extensors, maximum oxygen consumption (calcium, magnesium and T-proteine), bodily height, mass, and calculated Body-Mass-Index (BMI).

Before starting the experimental treatment, the groups were fully homogenous compared with all the measured variables. After the experiment, statistically significant changes have been determined only in the experimental group, and not for all variables, while no significant changes have been recorded in the control group (Tables 1 and 2). During the experiment, significant increase of muscle strength and $VO_2$ max occurred, with a decreased concentration of Beta-CTx (bone resorption marker) in calcium in the blood, while tP1NP remained unchained. This indicates that the treatment had been stimulative enough only to improve metabolic and motor functions, and to slow down degradative processes in the bones, but not for construction of bone mass. There has been an unexpected decrease of calcium concentration in the blood, a nutrient significant for bone construction. Even though not statistically significant, there has been a decrease of superoxide dismutase (SOD), which is an important anti-oxidant. The decrease of the aforementioned seemed confusing at first glance. It ap-

nje (Rautava, 2007). Nekoliko naučnih radova ukazuje na pozitivan uticaj sistematske fizičke aktivnosti na masu kosti (Kohrt et al., 2004; Bošković et al., 2013; Roghani, 2013). Sa druge strane, fizička neaktivnost (hipokinezija) negativno utiče na remodelovanje kosti i povećava resorpciju (Gupta, et al., 2014). Osim direktnog uticaja na kosti, hipokinezija smanjuje mišićnu snagu što utiče na pad sposobnosti lokomotornog aparata i povećava rizik od padova i preloma (Ye, Wu, & Wu, 2013).

Polazeći od nalaza prethodnih studija koje ukazuju na pozitivan uticaj fizičke aktivnosti na ublažavanje posledica osteopenije, na Fakultetu za sport i turizam u Novom Sadu realizovan je eksperiment sa 26 žena u postmenopauzi, starosti između 46 i 58 godina kod kojih je DXA metodom konstatovana osteopenija. Uzorak je podeljen u dve grupe – eksperimentalnu i kontrolnu. U eksperimentalnoj grupi primenjen je kombinovani program vežbanja koji se sastojao od aerobnih aktivnosti i vežbi snage, dok kontrolna grupa nije vežbala. Program je trajao 7 sedmica, sa tri treninga nedeljno i danom pauze između njih. Intenzitet aerobnog treninga se kretao između 60% i 70% srčane rezerve, a intenzitet treningu snage između 60% i 85% jednog repetitivnog maksimuma (1RM). Pre i posle eksperimenta izmereni su: nivo biohemijskih markera u serumu (Beta-CTx, tP1NP i izoenzima ALP), biohemijski parametri izgradnje (kalcijum, magnezijum, T-protein), 1RM ekstenzora nogu, maksimalna potrošnja kiseonika ($VO_2$max), telesna visina i masa i izračunat Body-Mass-Index (BMI).

Grupe su su pre početka eksperimentalnog tretmana bile potpuno homogene u odnosu na sve izmerene varijable. Nakon eksperimenta statistički značajne promene utvrđene su samo u eksperimentalnoj grupi i to ne za sve varijable, dok u kontrolnoj grupi nije evidentirana ni jedna značajna promena (Tabele 1 i 2). Tokom trajanja eksperimenta došlo je do značajnog povećanja mišićne snage i $VO_2$ max, uz smanjenje koncentracije Beta-CTx (marker koštane resorpcije) i kalcijuma u krvi, dok su tP1NP (marker formiranja kosti) i ALP (parametar metabolizma i remodelovanja) ostali gotovo nepromenjeni. To pkazuje da je tretman bio dovoljno stimulativan samo za poboljšanje metaboličkih i motoričkih funkcija, te za usporavanje degenerativnih procesa u kostima, ali ne i za izgradnju koštane mase. Nečekivano je došlo i do smanjenja koncentracije kalcijuma u krvi, nutritijenta značajnog za izgradnju kosti. Iako ne statistički značajno, smanjila se superoksiddimutaze (SOD), važan antioksidans. Ova smanjenja

peared that systematic exercise causes a negative response of the bone instead of creating progress. By using logical analysis, however, it was concluded that the decrease of calcium in the blood is the consequence of its transmission into the bones, where it is more necessary. The decrease of SOD has been explained through the conclusion that the training, particularly in beginners, has a stressful effect and increases the concentration of free radicals in the blood, and so, the SOD was most likely demonstrating its anti-oxidant effect during the experimental treatment.

The demonstrated results did not convincingly prove the efficiency of physical exercise in women with osteopenia, which could cast doubt on the justifiability of the application of health fitness. By a more thorough interpretation of the findings, however, some other principles significant for the promotion of health fitness stand out. Primarily it is noted how important knowledge of this matter is, meaning the significance of having specific education. Health fitness, particularly in working with sensitive groups, requires high expert knowledge. The other important observation, masked by non-critical and superficial acceptance of the results, is related to the length of time necessary to cause positive effects. This Novi Sad study has, without a doubt, demonstrated that, apart from the strength of the stimulus, it is necessary to take consideration also of its duration when it comes to health fitness. Sometimes 2-3 months are not enough to cause adaptive changes, which is the reason why many trainees frequently give up on the treatment and declare the fitness trainers as incompetent. Highly educated trainer, however, will provide good arguments for the trainee and lead them into patiently waiting for the first effects of their labor.

su u prvi mah delovala zbunjujuće. Izgledalo je kao da sistematsko vežbanje umesto napretka izaziva negativan odgovor kosti. Logičkom analizom, međutim, zaključeno je da je smanjenje kalcijuma u krvi posledica njegovog prelaska u kosti, tamo gde je potrebniji. Smanjenje SOD-a objašnjeno je time što trening, naročito kod početnika, deluje stresno i povećava koncentraciju slobodnih radikala u krvi, pa je SOD verovatno intenzivnije ispoljavao svoje antioksidansno dejstvo tokom eksperimentalnog tretmana.

Prikazani rezultati nisu ubedljivo dokazali efikasnost fizičkog vežbanja kod žena sa osteopenijom, što bi moglo da dovede u sumnju opravdanost primene zdravstvenog fitnesa. Pažljivijim tumačenjem nalaza, međutim, nameću se još neki principi značajni za promciju zdravstvenog fitnesa. Pre svega zapaža se koliko je važno poznavanje ove materije, odnosno koliko je značajno posedovati specifičnu edukaciju. Zdravstveni fitnes, naročito u radu sa osetljivim grupama, zahteva visoko ekspertno znanje. Drugo važno zapažanje, zamaskirano nekritičnim i površnim prihvatanjem rezultata, odnosi se na dužinu vremena neophodnog za izazivanje pozitivnih efekata. Ova novosadska studija nedvosmisleno je pokazala da je, osim jačine stimulansa, u zdravstvenom fitnesu neophodno voditi računa i o njihovom trajanju. Nekada su 2-3 meseca nedovoljna za izazivanje adaptacionih promena zbog čega vežbači često odustaju od tretmana i fitnes trenere proglašavaju nekompetentnima. Vrhunski edukovan trener, međutim, vežbaču će dati dobru argumentaciju i navesti ga da strpljivo sačeka prve efekte svog rada.

***Table 1:*** *Descriptive statistics of pre-test and post-test for experimental and control group*

**Tabela 1***: Prosečne vrednosti varijabli pre i posle eksperimentalnog tretmana*

| | | | Pretest / *Pre-test* | | Pretest / *Post-test* | |
|---|---|---|---|---|---|---|
| **Variabla / *Variables*** | **Groupa / *Group*** | ***N*** | ***Mean*** | ***Std.Dev*** | ***Mean*** | ***Std.Dev*** |
| *Beta-CTx (pg/ml)* | Eksperimentalna / *Experimental* | 15 | **550.87** | 164.474 | **489.09** | 175.662 |
| | Kontrolna / *Control* | 11 | **489.09** | 175.662 | **438.00** | 157.425 |
| *tP1NP (mcg/L)* | Eksperimentalna / *Experimental* | 15 | **68.27** | 19.295 | **64.78** | 24.1653 |
| | Kontrolna / *Control* | 11 | **55.12** | 14.167 | **52.29** | 15.716 |
| *ALP (U/L)* | Eksperimentalna / *Experimental* | 15 | **77.07** | 18.425 | **74.47** | 19.272 |
| | Kontrolna / *Control* | 11 | **72.55** | 26.909 | **74.73** | 27.626 |
| *Leg-Press (kp)* | Eksperimentalna / *Experimental* | 15 | **118.93** | 40.006 | **168.53** | 40.977 |
| | Kontrolna / *Control* | 11 | **119.70** | 40.255 | **118.10** | 34.936 |
| *$VO_2$max (ml/kg/min)* | Eksperimentalna / *Experimental* | 15 | **29.77** | 4.831 | **32.76** | 4.317 |
| | Kontrolna / *Control* | 11 | **28.82** | 3.882 | **28.61** | 3.787 |
| Kalcijum / *Calcijum (mmol/L)* | Eksperimentalna / *Experimental* | 15 | **2.43** | .076 | **2.33** | .054 |
| | Kontrolna / *Control* | 11 | **2.32** | .071 | **2.33** | .054 |
| *SOD (U/L)* | Eksperimentalna / *Experimental* | 15 | **1422.93** | 159.057 | **1337.07** | 164.658 |
| | Kontrolna / *Control* | 11 | **1366.30** | 208.989 | **1480.10** | 169.883 |

***Table 2:*** *Statistics of Mixed between-within subjects ANOVA*

***Tabela 2:*** *Rezultati dvofaktorske analize varijanse o uticaju specifičnosti grupa i eksperimentalnog tretmana na promene varijabli iz Tabele 1.*

| Variable | Wilks' Lambda | F | Sig. | Partial Eta Squared |
|---|---|---|---|---|
| **Beta CTx** | | | | |
| Kombinovani uticaj / *Treatment^Group impact* | .913 | 2.280 | .144 | .087 |
| Uticaj tretmana / *Treatment impact* | .578 | 17.553 | .000 | .422* |
| Uticaj grupe / *Group difference* | | .226 | .639 | .009 |
| **tP1NP** | | | | |
| Kombinovani uticaj / *Treatment^Group impact* | .999 | .025 | .876 | .001 |
| Uticaj tretmana / *Treatment impact* | .915 | 2.227 | .149 | .085 |
| Uticaj grupe / *Group difference* | | 3.035 | .094 | .112 |
| **ALP** | | | | |
| Kombinovani uticaj / *Treatment^Group impact* | .930 | 1.807 | .191 | .070 |
| Uticaj tretmana / *Treatment impact* | .999 | .014 | .907 | .001 |
| Uticaj grupe / *Group difference* | | .058 | .812 | .002 |
| **Leg-Press** | | | | |
| Kombinovani uticaj / *Treatment^Group impact* | .329 | 49.028 | .000 | .671* |
| Uticaj tretmana / *Treatment impact* | .357 | 43.281 | .000 | .643* |
| Uticaj grupe / *Group difference* | | 54.993 | .000 | .817* |
| **$VO_2$ max** | | | | |
| Kombinovani uticaj / *Treatment^Group impact* | .478 | 25.105 | .000 | .522* |
| Uticaj tretmana / *Treatment impact* | .548 | 18.947 | .000 | .452* |
| Uticaj grupe / *Group difference* | | 10.388 | .013 | .216* |
| **Kalcijum** | | | | |
| Kombinovani uticaj / *Treatment^Group impact* | .695 | 6.964 | .015 | .240* |
| Uticaj tretmana / *Treatment impact* | .760 | 9.636 | .005 | .305* |
| Uticaj grupe / *Group difference* | | 5.859 | .024 | .210* |
| **SOD** | | | | |
| Kombinovani uticaj / *Treatment^Group impact* | .854 | 3.751 | .066 | .146 |
| Uticaj tretmana / *Treatment impact* | .997 | .073 | .789 | .003 |
| Uticaj grupe / *Group difference* | | .734 | .401 | .032 |

**Statistically significant difference*

### *Example 3: Is there a happiness hormone?*

A notable example which provides a good illustration of the manipulations in the sphere of health fitness is the story of "happiness hormones" - endorphin and serotonin. Often, in literature (both expert and quasi-scientific), there are cases pointing out that exercising stimulates the secretion of these two hormones. This data is not inaccurate but it is wrongly interpreted. What exactly are endorphin and serotonin? They are biochemical compounds from the group of peptides, which act as enzymes and neurotransmitters. They are very similar to opiates and they are secreted by hypothalamus as its endocrine hormones (Nelson &Coc, 2005). They are most secreted during high-intensity physical strain, as discovered by a group of Scottish scientists in a laboratory in Aberdeen

**Statistički značajan uticaj*

### *Primer 3: Da li postoji hormon sreće?*

Upečatljiv primer koji dobro ilustruju manipulacije u sferi zdravstvenog fitnesa je priča o „hormonima sreće" – endorfinu i serotoninu. Ne retko se u literaturi (kako stručnoj tako i kvazinaučnoj) ističe kako vežbanje podstiče lučenje ova dva hormona. To nije netačan podatak, ali je pogrešno njegovo tumačenje. Šta su egzaktno endorfin i serotonin? To su biohemijska jedinjanja iz grupe peptida, a deluju kao enzimi i neurotransmiteri. Vrlo su slični opijatima, a luči ih hipotalamus kao svoje endokrine hormone (Nelson & Coc, 2005). Najviše se luče tokom fizičkih naprezanja visokog intenziteta što je otkrila grupa škotskih naučnika iz laboratoriji u Aberdinu (Stefano et al., 2012). Prvi su ih izolovali 1975. godine Džon Hjuz i Hans Kosterlic iz mozga

(Stefano et al., 2012). They were first isolated from a pig brain by John Hughes and Hans Kosterlitz in 1975, who explained them as amino-acids polymers linked by peptide connections. In most, five connections existed, which is why they were called penta-peptides. They acted as inhibitors of neurotransmitters, primarily between the spinal cord and peripheral nerves. Such effect caused a decrease of the sensation of pain in the muscles after heavy labor (Hughes, Smits, Kosterlitz, et al., 1975). Due to this effect, it was given the name enkephalin opioids (Kosterlitz& Hughes, 1977). At the same time, on the other side of the Atlantic, a group of American scientists had isolated the same biochemical compounds from the brain of a calf and confirmed their opiate effect (Simanov& Snyder, 1976). The title endorphin is attributed to Eric Simon, an American researcher, who had, independently from his predecessors, isolated opiate receptors from the vertebral human spine, to which he attributed the characteristic of endogenous morphine, meaning, internal narcotic produced by the human brain (Simon, 1974; Bonnet & Simon, 1982; Onoprishvili& Simon, 2007). Endorphin had the same effect as Hughes' and Kosterlitz'spenta-peptides, meaning, it inhibited peripheral neurotransmitters. Later on, pentapeptide of similar effect was discovered in some groceries rich in amino-acid tryptophan and called serotonin (Stephano et al., 2012). Apart from the brain, where it is significant for sleep regulation, it can be found in the gastro-intestinal system (in the neuroendocrine cells) as well as in thrombocytes where it participates in the coagulation process. Unlike endorphin, which is produced exclusively by pituitary gland, serotonin can be ingested through food. There is also medicines containing serotonin. They cause euphoria and are used in treating depression.

Increased concentration of endorphins in the peripheral neurotransmitters is retained for about two hours causing the feeling of relaxedness in the muscles. If following the exercise nutrients high in serotonin are additionally consumed (chocolate, wine, fruit), this leads to additional decrease of nerve endings sensitivity, which causes the nice feeling usually felt after a good workout. Precisely due to this feeling, endorphin and serotonin have been (falsely) declared as happiness hormones. Many fanatic exercisers, after the limited feeling of these two opiate penta-peptides fades away, wish to regain the lost feeling of bodily relaxedness and immediately initiate into new physical activity (new fitness training). In time, they turn into training addicts, thje same as any other opiate (narcotics) addicts. Endorphin addicts can be recognized on trim tracks, marathon races, in gyms and all the places where the body is daily exposed to more and more exhaustion. After a certain period of such immodsvinje i objasnili kao polimere aminokiselina povezane peptidnim vezama. Kod većine njih je egzistiralo pet veza, zbog čega su ih nazvali pentapeptidi. Delovali su kao inhibitori neurotransmitera, prvenstveno između kičmene moždine i perifernih nerava. Takvo dejstvo izazivalo je umanjenje osećaja bola u mišićima nakon teškog rada (Hughes, Smith, Kosterlitz, et al., 1975). Zbog takvog dejstva dodelili su im i naziv enkefalinski opijati (Kosterlitz & Hughes, 1977). U isto vreme, ali sa druge strane Atlantika, grupa američkih istraživača je iz mozga teleta izolovala ista biohemijska jedinjenja i potvrdila njihovo opijatsko dejstvo (Simantov & Snyder, 1976). Naziv endorfin pripisuje se američkom istraživaču Ericu Sajmonu koji je, nezavisno od prethodnika, iz vertebralne kičme čoveka izolovao opijatne receptore kojima je pripisao svojstvo endogenog morfijuma, odnosno, unutrašnjeg narkotika koji proizvodi ljudski mozak (Simon, 1974; Bonnet & Simon, 1982; Onoprishvili & Simon, 2007). Endorfin je imao isto dejstvo kao Hjuzovi i Kosterlicovi pentapeptidi, odnosno, inhibirao je periferne neurotransmitere. Kasnije je, u nekim namirnicama bogatim aminokiselinom triptofanom otkriven pentapeptid sličnog dejstva i nazvan Serotonin (Stefano et al., 2012). Osim u mozgu, gde je značajan za regulaciju sna, ima ga dosta u gastrointestinalnom sistemu (u neuroenndokrinim ćelijama) i u trombocitima gde učestvuje u procesu koagulacije. Za razliku od endorfina kojeg stvara isključivo hipofiza, serotonin se može uneti i hranom. Postoje i medikamenti koji sadrže serotonin. Oni izazivaju euforiju i koriste se u lečenju depresije.

Povećana koncentracija endorfina u perifernim neurotransmiterima se zadržava oko dva sata izazivajući osećaj opuštenosti u mišićima. Ukoliko se nakon vežbanja dodatno kozumiraju namirnice koje sadrže serotonin (čogolada, vino, voće) dolazi do dotatnog smanjenja osetljivosti nervnih završetaka, što prouzrokuje ono lepo stanje koje se oseća nakon dobrog treninga. Upravo zbog tog osećanja, endorfin i serotonin su proglašeni (lažnim) hormonima sreće. Mnogi fanatični vežbači, nakon što iščili ograničeno dejstvo ova dva opijatna pentapeptida, žele da povrate izgubljeni osećaj telesne opuštenosti i odmah kreću u novu fizičku aktivnost (novi fitnes trening). Vremenom postaju zavisnici od treninga, kao i svaki zavisnik od opijata (narkotika). Endorfinski zavisnici prepoznaju se na trim stazama, maratonskim trkama, u teretanama i na svim mestima gde se telo iz dana u dan izlaže sve većem iscrpljivanju. Posle izvesnog perioda takvog neumerenog izlaganja fizičkom vežbanju, organizam ulazi u hronični zamor i

erate exposure to physical exercise, the body enters chronic fatigue and the state of general exhaustion. Frequently it leads to serious health problems (metabolic disorders, loss of sleep, physical tissue damages, injuries, etc.).

## Conclusion

Lumbar syndrome analysis, results of the experiment with osteopenia, and the story about fake happiness hormones (endorphin and serotonin) served the purpose of indicating the importance of one of the most important principles in health fitness – determining a measure. It is important to know that a universal measure and a universal recipe does not exist. Optimal volume, intensity and the kind of physical activity are extremely individual and each trainee must continuously search from them. In their search, education and introspection play the crucial role. Knowledge must be continually revised by developing a critical relationship towards all marketing manipulations heavily present in the modern fitness industry. Each change is in the function of time, so the trainees must wait patiently to see the effects of dosed physical activity. The effects of health fitness can occur only if the person is continually physically active throughout their life. 15 kilograms cannot be lost in 15 days, nor is there an exercise which "removes" fat precisely from the stomach; fat cannot be turned into muscles, nor are there "fat melters" in a pharmacy. Only a person who truly understands biochemical and physiological processes at the core of human movement and muscle activity can feel the benefits of health fitness.

stanje opšte iscrpljenosti. Često nastaju i ozbiljni zdravstveni problemi (poremećaji metabolizma, gubitak sna, fizička oštećenja tkiva, povrede itd.).

## Zaključak

Analiza lumbalnog sindroma, rezultati eksperimenta sa osteopenijom i priča o lažnim hormonima sreće (endorfinu i serotoninu) imala je za cilj da ukaže na značaj jednog od najvažnijih principa u zdravstvenom fitnesu – traženje mere. Važno je znati da univerzalna mera i univerzalni recept ne postoji. Optimalan obim, intenzitet i vrsta fizičke aktivnosti su krajnje individualne i za njima svaki vežbač mora neprekidno da traga. U tom traganju edukacija i introspekcija imaju presudnu ulogu. Znanja moraju konstantno da se obnavljaju, uz razvijanje kritičkog odnosa prema svim marketinškim manipulacijama kojima obiluje moderna fitnes industrija. Svaka promena je u funkciji vremena i zato se efekti dozirane fizičke aktivnosti moraju strpljivo čekati. Efekti zdravstvenog fitnesa se ostvaruju samo ukoliko je čovek fizički aktivan kontinuirano tokom čitavog života. Za 15 dana se ne može izgubiti 15 kilograma, niti postoji vežba kojom se masne naslage „skidaju" baš sa stomaka; masti se ne mogu pretvoriti u mišiće, niti u apoteci postoje „topljači masti"... Samo onaj ko dobro razume biohemijske i fiziološke procese na kojima počivaju ljudsko kretanje i mišićna aktivnost, moći će da oseti benefite zdravstvenog fitnesa.

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