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DRAGI ČITAOCI,

Zajedno smo ušli u šestu godinu postojanja časopisa "Sportske nauke i zdravlje". Naš Časopis je od ovog broja indeksiran i u međunarodnoj citatnoj bazi Erih plus. Broj prijavljenih radova je sve veći, a isti se mogu slati putem online obrasca na redizajniranoj web stranici Časopisa www.siz-au.com.

U ovom broju ćete pronaći zanimljive članke autora iz pet država. Isti obrađuju različite teme sa zanimljivim istraživanjima, a koja se odnose na procjenu aktivnog životnog stila studenata, rano otkrivanje i prevenciju gojaznosti kod mladih, odnosu posturalnog statusa stopala i eksplozivne snage donjih ekstremiteta, promjenama funkcionalnih sposobnosti pod uticajem rekreativnog plivanja, efekte kinezioloških aktivnosti na transformaciju morfoloških karakteristika i motoričkih sposobnosti kod žena, zdravstvenim pokazateljima kod fudbalera, hijerarhijsko struktuiranje ekspertnog modela za podučavanje osnovnog skijaškog zavoja i relacijama motoričkih sposobnosti i tehničko-taktičkih elemenata u stonom tenisu.

I na kraju neka nam vodilja bude misao Fransisa Bejkona: "Lukavi ljudi preziru nauku, priprosti joj se dive, a mudri se njome koriste".

UREDNIŠTVO ČASOPISA

DEAR READERS,

This is the sixth year of the journal "Sports Science and Health". Since this edition, our journal is indexed and is part of the international ERIH PLUS database. The number of the papers is increasing, and they could be sent via online form on the re-designed web page of our journal www.siz-au.com

This issue has some interesting papers written by the authors from five countries. They analyze various topics with very interesting research, dealing with the evaluation of the scale of perception of active student life style, early detection and prevention of overweight in young people, relation between the postural feet status and explosive strength of the lower extremities, changes of functional abilities of women under the influence of re-creative swimming, effects of kinesiological activites on transformation of the morphological characteristics and motor abilities of women, health indicator of the football players, hierarchical classification metodical model for teaching basic ski turn and relationship between motor abilities and technical and tactical characteristics in table tennis.

And for the end, let the motto of Fransis Bacon lead you: „Crafty men condemn studies, simple men admire them, and wise men use them“.

JOURNAL EDITORIAL

EVALUACIJA SKALE PERCEPCIJE AKTIVNOG ŽIVOTNOG STILA STUDENATA

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EVALUATION OF THE SCALE OF PERCEPTION OF ACTIVE LIFESTYLE OF STUDENTS

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Apstrakt: Problem prisutnosti zdravih životnih navika kod mladih, a u tom kontekstu i sve intenzivnije afirmacije aktivnog stila života, danas je jedno od najčešće postavljenih pitanja kada se sagledavaju njihovi uslovi života i rada. Istraživanja pokazuju da je prisutan trend porasta broja mladih, posebno među studenatskom populacijom, kod kojih dominiraju životne navike okarakterisane kao nezdrave.

Istraživanje koje je sprovedeno na uzorku od 240 ispitanika, studenata Fakulteta za sport i turizam iz Novog Sada i Visoke škole strukovnih studija za obrazovanje vaspitača i trenera iz Subotice, imalo je za cilj identifikaciju neophodnih elemenata koji bi odražavali konstrukt skale kojom se mogu utvrđivati osnovni elementi percepcije aktivnog životnog stila kod studentske populacije. Primenom namenski konstruisanog upitnika (*Perception of Active Lifestyle*) izvršena je procena jednog broja indikatora koji ukazuju na intenzitet percepcije prisutnosti determinanti aktivnog životnog stila kod studenata.

Dobijeni rezultati pokazuju da primjenjeni upitnik odlikuje 15 stabilnih indikatora (ajtema) i da skala PAŽ ima dobru unutrašnju saglasnost ($Ch.\alpha = .865$). Faktorskom analizom utvrđena je i odgovarajuća validnost skale ($KMO = 0.690$; $Sig. = 0.000$), a analizom glavnih komponenti postignuta je statistički prihvatljiva parsimonija i definisana njena jednofaktorska struktura. Ovaj upitnik je moguće primeniti kao jedinstvenu skalu koja u manifestnom prostoru rezultira prosečnom vrednošću (skalarnim prosekom) izračunatom iz ocena kojima ispitanici vrednuju pojedine aspekte individualne percepcije aktivnog životnog stila.

Ključne reči: percepcija, aktivni životni stil, skala, studenti.

Abstract: In that context of ever more intensive affirmation of active lifestyle, the problem of the presence of healthy lifestyle habits in the young population is today one of the most frequently asked questions when evaluating their conditions of life and work. Research shows that there is a growing trend in the number of youth, especially amongst the student population, who predominantly exhibit lifestyle habits characterized as unhealthy.

The research conducted on a sample of 240 examinees, students of The Faculty for Sports and Tourism from Novi Sad and the College of Vocational Studies for preschool teachers and sports trainers from Subotica, had as an aim to identify the necessary components that would reflect the construct of the scale used to determine the basic elements of perception of active lifestyle in the student population. By applying the purposefully constructed questionnaire (*Perception of Active Lifestyle*) an evaluation was conducted of a certain number of indicators pointing to perception intensity of the presence of healthy lifestyle determinants in students. The results show that the applied questionnaire is distinguished by 15 stable indicators (items), and that the PAL scale has a good internal consistency ($C. \alpha = .865$). By factor analysis, a suitable scale validity was determined ($KMO = 0.690$); ($Sig=0.000$), and the analysis of main components achieved a statistically acceptable parsimony and defined a single constituent structure. It is possible to apply this questionnaire as a unique scale that results in average value (scalar average) in manifested space, calculated from the grades given by the examinees to certain aspects of individual perception of active lifestyle.

Keywords: perception, active lifestyle, scale, students.

Uvod

Za pojam životnog stila može se reći da predstavlja simbiozu prihvatanja određenih vrednosti i ponašanja, odnosno sačinjen je od spoja implicitnih i eksplizitnih vrednosnih determinanti (ljudi se međusobno opažaju kao pripadnici nekog životnog stila i deluju u skladu s njim; usredsređeni su na primenu znanja, ponašanja i vrednosti kojima pridaju normativna značenja – npr: etička, sportska, politička i sl.) (Miliša & Bagarić, 2012, str. 85).

Savremena teorija i praksa koja se bavi pitanjima zdravog načina života kod mlađih zastupa stanovište po kome je osnova aktivnog životnog stila determinisana skupom određenih ponašanja, postupaka i/ili navika. Ukoliko se one posmatraju parcijalno, svaka za sebe, tada ne predstavljaju posebno „interesantne“ odrednice koje mogu značajnije uticati na zdravlje. Međutim, ako se određeni obrazac ponašanja mlađog čoveka posmatra (koji obuhvata sintezu pravilnih postupaka, zdravih navika i adekvatnog ponašanja i odnosa „prema samom sebi i drugima“), tada se može govoriti o aktivnom životnom stilu (Nešić i sar., 2015).

Pojedine aktuelne studije koje su rađene poslednjih godina (Kvaak, Meyer & Tverdal, 2004; Myint i sar., 2007; Međedović, Perić i Ahmetović, 2013) ukazale su na nizak nivo fizičke i radne sposobnosti savremenog čoveka, što kao posledicu ima nepovoljan uticaj na njegovo zdravlje. Za glavnog uzročnika je nedvosmisleno proglašen tzv. „morbogeni trijas faktora“ koji obuhvata: hipokineziju, gojaznost i stresna prenaprezanja, tako da se prihvatanje zdravih stilova života danas sve više propagira kao važan zadatak društva koji je usmeren na očuvanje javnog zdravlja. Stoga aktivni životni stil objedinjuje svest i stalnu borbu protiv faktora rizika, odnosno aktivnosti za unapređenje kvaliteta života. Povećanje nivoa fizičke aktivnosti i usvajanje pravilnih nutritivnih navika dva su najčešće apostrofirana zadatka u preporukama zdravstvenih i kinezioloških institucija (Nešić i sar., 2014).

Jedan broj istraživanja, koja su intenzivnije povezana i sa aktivnim životnim stilom mlađih, definisalo je sintagmu –zdravi životni stil (*healthy lifestyle*). On se uglavnom definiše kao aktivno bavljenje fizičkim vežbanjem, sportom i rekrekcijom (Pierro, Mannetti & Livi, 2003), a vezu sa aktivnim životnim stilom (*active lifestyle*) temelji na istraživanjima koje ga definišu kroz identifikaciju količine kretanja tokom određenog vremenskog perioda (Nešić i sar., 2014). Aktivan životni stil danas se smatra jednom od najsnažnijih „uzdanica“ na putu ka ličnom zdravlju i vitalnosti, u punom smislu ovih pojmovova. Ova-

INTRODUCTION

The term lifestyle can be said to represent a symbiosis of accepting certain values and behaviours, meaning that it consists of a joining of implicit and explicit determinants of value (people interchangeably observe each other as belonging to a certain lifestyle and act accordingly; they are focused on the application of knowledge, behaviours and values characterized by normative meanings – for e.g. ethical, sports, political etc.) (Miliša and Bagarić, 2012, pg. 85).

Modern theory and practice that deals with the issues of healthy lifestyle in youth is of the standpoint that the basis of active lifestyle is determined by a set of certain behaviours, actions and/or habits. If they are observed partially, each one individually, they are not particularly “interesting” determinants that can be of more significance to health. However, if a certain pattern of behaviour of a young person is observed (that includes a synthesis of proper actions, healthy habits and adequate behaviour and relation “towards oneself and others”) then active lifestyle can be discussed (Nešić et al., 2015).

Certain current studies made in recent years (Kvaak, Meyer and Tverdal, 2004; Myint et al., 2007; Međedović, Perić and Ahmetović, 2013), have pointed to a low level of physical and work ability of the modern person, which consequently has a negative influence on health. Undoubtedly, the main cause is the so called “morbifictrias of factors” that include: hypokinesia, obesity and stressful exertion, so that, today, acceptance of healthy lifestyles is even more promoted as an important task of a society focused on maintaining public health. Therefore, active lifestyle unifies the awareness and the constant fight against risk factors, meaning activities improving the quality of life. Increasing physical activity and adopting proper nutritive habits are two most often apostrophized tasks in the recommendations of health and kinesiology institutions (Nešić et al., 2014).

A certain number of research studies, which were interlinked more intensely with an active lifestyle of youth, were defined by the phrase healthy lifestyle. It is mostly defined as actively engaging in physical exercise, sports and recreation (Pierro, Mannetti and Livi, 2003), and the link with active lifestyle is based on the research that defines it by identifying the amount of motion during a certain time period (Nešić et al., 2014). Today, active lifestyle is considered to be one of the strongest “hopes” on the journey to personal health and vitality, in the full sense of these terms. Such context in the perception of active lifestyle, i.e. healthy way of life, is represented in the so called *healthy lifestyle doctrine* (Sharrkey and

kav kontekst u poimanju aktivnog životnog stila, odnosno zdravog načina života, zastupljen je kroz tzv. *Zdravstvenu doktrinu aktivnog stila života* (Sharrkey & Gaskill, 2008). On obuhvata sledeće međusobno integrisane komponente: a) fizičku aktivnost, b) zdravu i pravilnu ishranu, c) kontrolu telesne težine, d) kontrolu stresa i f) sigurnosne navike. Zdrav (aktivni) životni stil bi trebalo posmatrati kao višedimenzionalni sistem ponašanja pojedinca koji nije determinisan isključivo fizičkim aktivnostima. Njega određuju i druga ponašanja i navike koje su povezane sa zdravljem – pravilna ishrana, redovni prevetivni zdravstveni i stomatološki pregledi, redovna kontrola krvnog pritiska, kontrola stresa, eliminisanje štetnih životnih navika (konsumiranje alkohola, pušenje i sl.).

U kontekstu ovog istraživanja aktivni životni stil je dimenzioniran kao segmentirani konstrukt ponašanja koje odražava dominantu orijentaciju studenata ka navikama koje ih orijentišu prema aktivnom ponašanju u odnosu na određene životne aktivnosti, odnosno, pojedine sadržaje koji dominantno sačinjavaju aktivan životni stil, prema modelu zdravstvene doktrine (Sharrkey & Gaskill, 2008). Kvantitativni iskazi, na ovakav način definisanog životnog stila, a koji su poslužili za analizu njegovih determinanti, obezbeđeni su indikatorima instrumenta istraživanja kojim su obuhvaćeni ključni elementi aktivnog životnog stila: 1) fizička aktivnost, 2) navike u ishrani, 3) odnos prema sopstvenom zdravlju, 4) stanje ličnih emocija i 5) sigurnosne navike.

METOD

Sprovedeno empirijsko istraživanje realizovano je u formi transverzalne studije, a imalo je za cilj identifikaciju neophodnih elemenata koji bi odražavali konstrukt skale kojom se mogu utvrđivati osnovni elementi percepcije aktivnog životnog stila kod studentske populacije.

Primenom namenski konstruisanog upitnika (*Percepcija Aktivnog Životnog Stila*) izvršena je procena jednog broja indikatora koji ukazuju na intenzitet percepcije prisutnosti determinanti aktivnog životnog stila kod studenata. Uzorak ispitanika je sačinjavalo 240 studenata Fakulteta za sport i turizam iz Novog Sada i Visoke škole strukovnih studija za obrazovanje vaspitača i trenera iz Subotice. Subuzorkovanje je zasnovano na polnoj pripadnosti ispitanika.

Primenjeni instrument konstruisan je kao skala za individualnu procenu osnovnih elemenata percepcije aktivnog stila života. Konačnoj verziji upitnika prethodilo je nekoliko probnih istraživanja na studentskoj populaciji u Novom Sadu. Inicijalni upitnik se sastojao od 28 tvrdnjki, ali je nakon provere metrike zadržano 15 ajte-

Gaskill, 2008). It includes the following, mutually integrated components: a) physical activity, b) healthy and proper diet, c) weight control, d) stress control, and f) safety habits. Healthy (active) lifestyle should be observed as a multidimensional system of individual's behaviour that is not exclusively determined by physical activities. It is also determined by other behaviours and habits that are linked with health – proper diet, regular preventive health and dental examinations, regular blood pressure control, stress control, eliminating harmful lifestyle habits (consuming alcohol, smoking etc.).

In the context of this research, active lifestyle is given dimension as a segmented behavioural construct that reflects the dominant orientation of students towards habits that guide them towards active behaviour in certain life activities, meaning certain contents that predominantly consist of active lifestyle, according to the model of health doctrine (Sharrkey and Gaskill, 2008). Quantitative accounts of, in this manner, defined lifestyle that were used to analyse its determinants, are ensured by using indicators of research instruments that include key elements of active lifestyle: 1) physical activity, 2) dietary habits, 3) relation towards own health, 4) the condition of personal emotions and 5) safety habits.

METHOD

The conducted empirical research was realised in the form of a transversal study, and had as its aim the identification of necessary elements that would reflect the construct of the scale, which can be used to determine the basic perception elements of active lifestyle in the student population.

By applying the purposefully constructed questionnaire (Perception of Active Lifestyle) a certain number of indicators were evaluated that point to the intensity of perception of active lifestyle determinants in students. The examinee sample consisted of 240 students of the Faculty of Sports and Tourism from Novi Sad and the College of Vocational Studies for preschool teachers and sports trainers from Subotica. The sub-sampling was based on the gender of the examinees.

The applied instrument was constructed as a scale for individual evaluation of basic elements of active lifestyle perception. The final version of the questionnaire was preceded by several test researches on the student population in Novi Sad. The initial questionnaire consisted of 28 claims, however, after metrics testing, 15 items were kept. The examinees showed their evaluation by selecting one of the five positions on a Likert type scale, where the grade 1 was the lowest, and the grade

ma. Ispitanici su svoju procenu iskazivali izborom jedne od pet pozicija na skali Likertovog tipa, gde je ocena 1 predstavljala najniži, a ocena 5 najviši intenzitet percepције prisutnosti svakog indikatora koji su činioci aktivnog životnog stila, prema konceptu zdravstvene doktrine (Sharrkey & Gaskill, 2008).

Metrika ove skale ocenjena je primenom dva postupka: (1) proverom njene unutrašnje saglasnosti (*Scale Reliability Analysis* koja je zasnovana na *Cronbach's Alpha* koeficijentu) i (2) faktorske analize (*Principal Components Analysis*) sa oblimin metodom rotacije (*Direct Oblimin*). Sva statistička zaključivanja sprovedena su na nivou značajnosti od 0,05 (*Sig. < .05*).

REZULTATI I DISKUSIJA

Uzorak ispitanika u ovom istraživanju karakterisalo je učešće ukupno 240 studenata koji pohađaju studijske programe fizičkog vaspitanja i sporta. Svi ispitanici su validno popunili istraživački instrument, tako da nije bilo nedostajućih podataka (*Missing*).

Tabela 1. Uzorak ispitanika / **Table 1.** Examinee sample

Ispitanici / Examinees	f	%
student (m) / students (m)	141	58.8
studentkinje (ž) / students (f)	99	41.3
Ukupno / Total	240	100.0
St. Dev.	.493	

Dobijeni rezultati analize metrike primenjene skale pokazuju da ona ima dobru unutrašnju saglasnost, na što ukazuje Kronbahov alfa koeficijent (*Cronbach's Alpha* = .865) koji je značajno veći od preporučene teorijske vrednosti 0.7 (De Vellis, 2003). Svi 15 ajtema imalo je visoku unutrašnju saglasnost, što skali daje dobre metrijske karakteristike i obezbeđuje korektnu interpretabilnost dobijenih podataka (Tabela 2).

Tabela 2. Koeficijenti unutrašnje saglasnosti skale PAŽS / **Table 2.** Coefficients of internal consistency of PAL scale

Br./ No.	Pitanje / Question	Cronbach's Alpha if Item Deleted
1	Redovnost bavljenja sportskim ili sportsko-rekreativnim sadržajima / Regularity of engaging in sports or sports-recreational activities	.854
2	Nivo svakodnevnih aktivnosti izvan kuće koje se obavljaju pešice / Level of everyday activities outside the house that are conducted by foot	.860
3	Korišćenje bicikla u obavljanju svakodnevnih poslova i aktivnosti / Using bicycles in conducting everyday tasks and activities	.859
4	Boravak u prirodi (na izletu) tokom vikenda / Time in nature (a field trip) during the weekend	.862
5	Procena sopstvene telesne kondicije / Evaluation of own fitness	.846
6	Trenutno zdravstveno stanje / Current health condition	.857
7	Stanje ličnih emocija / Personal emotions condition	.860
8	Redovnost uzimanja obroka (najmanje tri puta dnevno) / Regularity of meals (at least three times a day)	.854

5 was the highest intensity of perception of the presence of every indicator that is a factor of active lifestyle, according to the concept of health doctrine (Sharrkey and Gaskill, 2008).

The metrics of this scale was evaluated by applying two procedures: 1) by testing its internal consistency (*Scale Reliability Analysis* that is based on *Cronbach's Alpha* coefficient) and 2) factor analysis (*Principal Components Analysis*) with oblimin rotation method (*Direct Oblimin*). All statistical conclusions had level of significance of 0.05 (*Sig. < .05*).

RESULTS AND DISCUSSION

The sample of examinees in this research is characterized by the participation of 240 students who attend physical education and sports study programmes. All the examinees completed the research instrument validly, so that there were no missing data (*Missing*).

The results of metrics of the applied scale demonstrate that it has good internal consistency, as indicated by the *Cronbach's Alpha* coefficient (*Cronbach's Alpha* = .865), which is significantly higher than the recommended theoretical value of 0.7 (De Vellis, 2003). All 15 items had good internal consistency, which gives the scale good metric characteristics and ensures a correct interpretability of the received data (Table 2).

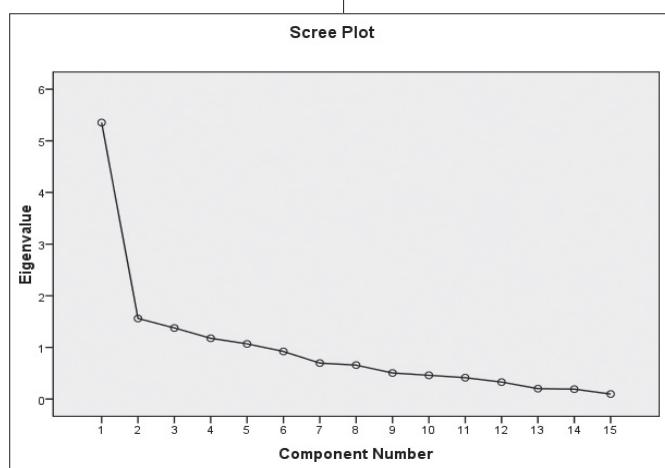
9	Kvalitet dnevnih obroka / Quality of daily meals	.854
10	Redovnost konzumiranja doručka / Regularity of consuming breakfast	.853
11	Korišćenje vode kao osnovnog dnevног napitka / Using water as the means of basic everyday hydration	.861
12	Korišćenje voća u dnevnoj ishrani / Using fruit in everyday diet	.845
13	Korišćenje povrća u dnevnoj ishrani / Using vegetables in everyday diet	.851
14	Redovnost odlaska na preventivne lekarske pregledе / Regularity of attending preventive doctor examinations	.849
15	Redovnost kontrole krvnog pritiska / Regularity of blood pressure control	.847
Cronbach's Alpha		.865

U cilju procene validnosti PAŽS upitnika svih 15 ajtema skale podvrgnuto je analizi glavnih komponenti (PCA). Pre sprovođenja PCA, bila je ocenjena prikladnost podataka za faktorsku analizu. Pregledom korelacione matrice evidentirano je mnogo koeficijenata vrednosti 0.3 i više. Prema Kajzer-Majer-Olkinovom kriterijumu (*Kaiser-Meyer-Olkin Measure of Sampling Adequacy*) neophodna preporučena vrednost od 0.6 (Kaiser, 1970, 1974) je u ovom slučaju bila premašena na statistički zadovoljavajućem nivou (0.690). Takođe je i Bartletov test sferičnosti (*Bartlett's test of sphericity*) (Bartlett, 1954) dostigao statističku značajnost ($Sig.= .000$), što sve ukazuje na faktorabilnost korelacione matrice.

Analiza glavnih komponenti dobijenih nakon Oblimin rotacije, otkrila je prisustvo pet komponenti sa karakterističnim vrednostima (*Eigenvalues*) preko jedan, koje objašnjavaju 35,68%, 10,40%, 9,17%, 7,84% i 7,12% varijanse. Međutim, dobijeni dijagram preloma (*Scree plot*) pokazao je postojanje jasne tačke loma već iza prve komponente (Slika 1).

With the aim of evaluating the validity of PAL questionnaire, all 15 scale items were subjugated to the analysis of the main components (PCA). Before conducting PCA, data suitability for factor analysis was evaluated. By inspecting correlational matrix, many coefficients of 0.3 and of higher value were recorded. According to the Kaiser-Meyer-Olkin criteria (Kaiser-Meyer-Olkin Measure of Sampling Adequacy), the necessary recommended value of 0.6 (Kaiser, 1970, 1974) was exceeded in this case on a statistically satisfactory level (0.690). Also, the Bartlett's test of sphericity (Bartlett, 1954) achieved statistical significance ($Sig.=.000$), all of which indicates the factorability of correlational matrix.

The analysis of the main components gained after Oblimin rotation revealed the presence of five components with characteristic values (Eigenvalues) over one, that explain 35.68%, 10.40%, 9.17%, 7.84% and 7.12% of the variability. However, the scree plot indicated the existence of a clear cut-off point right behind the first component (Image 1).



Slika 1. Tačka preloma (Scree Plot) skale PAŽS

Na osnovu Kattelovog kriterijuma (Kattel, 1966) odlučeno je da se zadrži samo jedna komponenta. To su podržali i rezultati paralelne analize sa jednom komponentom čije karakteristične vrednosti premašuju odgovar-

Image 1. Scree plot of PAL scale

Based on Kattel's criterion (Kattel, 1966), it was decided to keep only one component. This was supported by the results of a parallel one component analysis whose characteristic values exceed the suitable values

rajuće vrednosti praga dobijene pomoću jednako velike matrice slučajnih brojeva (15 varijabli x 240 ispitanika). Ovakvo jednofaktorsko rešenje (*single component*) objasnilo je prihvatljiv deo ukupne varijanse (35,68%), što je u skladu i sa preporučenim procedurama tumačenja rezultata faktorske analize (Pallant, 2009).

Svi 15 varijabli dalo je odgovarajuću faktorsku težinu jedinoj ekstrahovanoj komponenti (Tabela 3) čime je utvrđeno da PAŽS upitnik ima korektnu validnost, te da se može primenjivati kao samostalna multiajtemska skala za procenu percepcije aktivnog životnog stila kod studentske populacije.

of the threshold gained by using equally large matrix of random numbers (15 variables X 240 examinees). Such single component solution explained the acceptable part of the total variance (35.68%), which is in accordance with the recommended procedures of interpreting factor analysis results (Pallant, 2009).

All 15 variables gave suitable factorial gravity to the only extracted component (Table 3), which established that the PAL questionnaire has correct validity, and it can be applied as an independent multi-item scale for the evaluation of active lifestyle perception in student population.

Tabela 3. Deskriptivni pokazatelji PAŽS skale / **Table 3.** Descriptive indicators of PAL scale

RB/ No	Ajtemiskale / Scale Items	Matrica strukture / Structure matrix	Komunaliteti / Communalities
1	FA1	.618	.382
2	FA2	.454	.206
3	FA3	.462	.213
4	FA5	.449	.202
5	Z9	.741	.549
6	Z10	.548	.301
7	Z13	.444	.197
8	IS15	.601	.361
9	IS16	.626	.392
10	IS17	.616	.380
11	IS18	.417	.174
12	IS20	.760	.578
13	IS21	.687	.471
14	SN25	.677	.458
15	SN26	.700	.490

KMO Measure of Sampling Adequacy = .690

Bartlett's Test of Sphericity = 1691.032 Sig.= .000

Utvrđenim elementima metrijskih karakteristika primenjene skale dodatnu validnost daju i rezultati analize odgovora ispitanika kojima su iskazali intenzitet individualne percepcije aktivnog životnog stila. Uočljivo je da nisu utvrđene statistički značajne razlike u odnosu na polnu strukturu ispitanika, što dodatno daje pozitivnu dimenziju ovom instrumentu (Tabela 4). Ukupni skalarни proces (3.49) iz Tabele 4 jasno pokazuje da studenti pozitivno percepiraju prisustvo aktivnog životnog stila, odnosno smatraju ga činiocem svojih životnih navika, što je i u skladu sa karakterom ispitanika (studenti sporta). Međutim, nizak intenzitet skalarnih proseka na pozitivnom delu skale, kako uzorka u celini, tako i subuzoraka, otvaraju različita pitanja potencijalnih uzroka ovakvog

The validity of the determined elements of metric characteristics of the applied scale is also aided by the results of response analysis of the examinees who exhibited intensity of individual perception of active lifestyle. It is noticeable that no statistically significant differences were determined in relation to gender structure of the examinees, which gives an additional positive dimension to this instrument (Table 4). The total scalar process (3.49) from table 4, clearly indicates that the students perceive positively the presence of active lifestyle, meaning they consider it a factor in life habits, as is in accordance with the character of the examinees (students of sports). However, a low intensity of scalar averages on the positive part of the scale, as much on the sample in total, so much

stanja, što predstavlja zadatak za eventualne buduće studije na istraživačkim uzorcima ovakvog tipa.

Tabela 4. Deskriptivni pokazatelji za skalu PAŽS (One-Way Anova) / Table 4: Descriptive Indicators for PAL Scale (One-Way Anova)

Pol / Gender	N	Sv	Std.dev.	St.pog.	F	Sig
studenti (m) / students (m)	141	3.43	.685	.058		
studentkinje (ž) / students (f)	99	3.58	.596	.060	2.982	.085
Σ	240	3.49	.653	.042		

ZAKLJUČAK

Ova empirijska neeksperimentalna studija prikazala je konstrukciju i primenu jednog upitnika podesnog za procenu percepcije aktivnog životnog stila kod studenata. S provođenjem nekoliko probnih istraživanja, došlo se do definisanja ukupno 15 stabilnih indikatora (ajtema), što primjenom upitniku (PAŽS) daje dobra metrijska svojstva. Primenom procedure za identifikaciju unutrašnje saglasnosti skale (*Scale Reliability Analysis*) dobijena je visoka vrednost koeficijenta alfa (0,865), a faktorskom analizom je utvrđena i odgovarajuća validnost skale **Percepcija Aktivnog Životnog Stila** ($KMO = 0.690$; $Sig.= 0.000$). Analizom glavnih komponenti postignuta je statistički prihvatljiva parsimonija i definisana jednofaktorska struktura. U tom kontekstu ovaj upitnik je moguće primeniti kao jedinstvenu skalu koja u manifestnom prostoru rezultira prosečnom vrednošću (skalarnim prosekom) izračunatom iz ocena kojima ispitanici vrednuju pojedine aspekte individualne percepcije aktivnog životnog stila.

Rezultate ovog istraživanja bi trebalo tretirati i u širem kontekstu koji karakterišu sve izraženije tendencije da kod studentske populacije dominira izražena fizička neaktivnost, a to je problem koji može imati dugoročne implikacije na njihovo ukupno zdravlje. Naročito sa aspekta izbora budućeg zanimanja koje je, u ovom slučaju, karakteristično po svojoj osobenosti. Budući pedagozi (sportski stručnjaci i vaspitači) „moraju“ biti modeli društveno-prihvatljivog i zdravog ponašanja i načina života.

Primena konstruisanog upitnika prikazana je na primeru jednog broja studenata Fakulteta za sport i turizam i Visoke škole strukovnih studija za obrazovanje vaspitača i trenera. Od narednih istraživanja se očekuje da prikazani upitnik provere i na drugim tipovima visokoškolskih institucija i među studentskom populacijom koja nije dominantno opredeljena ka sportu, odnosno pedagoškom radu, kao svom budućem zanimanju. Polazeći od dobrih metrijskih karakteristika dobijenih u ovoj studiji,

on the sub-samples, opens various questions regarding the potential causes of such state, which is a task for possible future studies on the research samples of this type.

CONCLUSION

This empirical, non-experimental study has shown the construction and the application of a questionnaire suitable to evaluate the perception of active lifestyle in students. By conducting several test researches, 15 stable indicators (items) were identified in total, which gives the applied questionnaire (PAL) good metric properties. By applying identification procedure of internal consistency (*Scale Reliability Analysis*) high value of alpha coefficient was determined (0.865) and factor analysis also determined a suitable validity of *Perception of Active Lifestyle scale* ($KMO = 0.690$; $Sig.= 0.000$). By analysing the main components, a statistically acceptable parsimony was achieved as well as a defined single component structure. In this context, this questionnaire is applicable as a unique scale that, in manifested space, results in average value (scalar average) calculated from the grades given by the examinees to the individual aspects of perception of active lifestyle.

The results of this research should be treated in a wider context, which is characterized by the ever more prominent tendency showing expressed physical inactivity as predominant in the student population. That is a problem that can have long-term implications on their general health. Especially from the aspect of their future career choice, which is, in this case, characteristic in its uniqueness. Future educators (sports experts and preschool teachers) “must” be the models of socially acceptable and healthy behaviour and lifestyle.

The application of the constructed questionnaire is demonstrated on the example of a number of students of the Faculty of Sports and Tourism and the College for Vocational Studies for preschool teachers and sports trainers. It is expected of future research studies to evaluate the presented questionnaire using other types of institutions of high studies and amongst the student population that is not predominantly oriented towards sports, namely, towards pedagogical work as their future occupation. Starting from good metric characteristics gained

uz uvažavanje i određenih ograničenja ovog instrumenta, realno je očekivati da se upitnik pokaže pouzdanim i primenljivim u praksi.

in this study, with the consideration of certain limitations of this instrument, it is realistic to expect that the questionnaire will prove to be reliable and applicable in practice.

Izjava autora

Autori pridonijeli jednako.

Konflikt interesa

Mi izjavljujemo da nemamo konflikt interesa.

Authorship statement

The authors have contributed equally.

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We declare that we have no conflicts of interest.

LITERATURA / REFERENCES

- Bartlett, M.S. (1954). A note on the multiplying factors for various chi square approximations. *Journal of the Royal Statistical Society, 16* (Series B), 296-298.
- DeVellis, R.F. (2003). *Scale development: Theory and applications* (2nd ed.). Thousand Oaks, California: Sage.
- Kaiser, H. (1970). A second generation Little Jiffy. *Psychometrika, 35*, 401-415.
- Kaiser, H. (1974). An index of factorial simplicity. *Psychometrika, 39*, 31-36.
- Kattel, R. (1966). The scree test for the number of factors. *Multivariate Behavioral Research, 1*(2), 245-276.
- Kvaak, E., Meyer, H., & Tverdal, A. (2004). Food habits, physical activity and body mass index in relation to smoking status in 40–42 year old Norwegian women and men. *Preventive Medicine, 38*(1), January, 1-5.
- Mededović, B., Perić, D., & Ahmetović, Z. (2013). The physical work capacity of the students from Novi Sad. *FIS comunications*, Book of proceedings. Niš: Faculty of sport and physical education.
- Myint, P., Surtees, P., Wainwright, N., Wareham, N., Bingham, S., Luben, R., Wwlch, A., Smith, R., Harvey, I., & Khaw, K. (2007). Modifiable lifestyle behaviors and functional health in the European Prospective Investigation into Cancer (EPIC)-Norfolk population study. *Preventive Medicine, 44*(2), February, 109-116.
- Miliša, Z., & Bagarić, M. (2012). Behaviour Styles and Value Orientations. *Medianali, 6* (12), 68-104.
- Nešić, M., Perić, D., Ahmetović, Z., & Zubanov, V. (2014). Some lifestyle features of Novi Sad students in relation to the subjective perception of health. In: Pantelić, s. (ed.). *FIS komunikacije*, Zbornik radova, Niš: The Faculty of Sports and Physical Education, 388 – 397.
- Nešić, M., Rajić, D., Milić, Z., & Radoš, L. (2015). Life habits as a determinant of active lifestyle of Subotica students. In: Rajuć, D. (ed.) 8th International Interdisciplinary Scientific Conference «New Horizons in Education, Culture and Sports», *Zbornik radova*, Subotica: College of Vocational Studies for preschool teachers and sports trainers, 166-179.
- Pallant, J. (2009). SPSS Survival Manual. Belgrade: Mikro knjiga.
- Pierro, A., Mannetti, L., & Livi, S. (2003). Self-identity and the theory of planned behavior in the prediction of helath behavior and leisure activity. *Self & identity, 2*, 47-60.
- Sharrkey, J.B., & Gaskill, E.S. (2008). Exercise and Health. Belgrade: Datastatus.

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PERSONALIZED APPROACH TO EARLY DETECTION AND PREVENTION OF OVERWEIGHT IN YOUNG PEOPLE

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Abstract: The article presents the results of studying taste perception thresholds phenylthiocarbamide (FTC) in medical students in order to predict the genetic predisposition of their obesity and the nature of its course. Testing to the FTC, based on the method of Harris and Kalmus (1949), conducted in 339 healthy young people aged from 17 to 29 years. Subjects offered strips of filter paper soaked in solutions of various concentrations of FTC, starting with the lowest dilution to a clear sense of bitter taste. The study found that among people who suffer from excessive and obese, almost twice as likely to occur non-testery compared with healthy people. To recognize the bitter taste phenylthiocarbamide examined patients required significantly more concentrated solutions of the FTC. The observed statistically significant differences in the characteristics of perceptual sensitivity thresholds to allow the FTC to use this test to identify genetic predisposition to obesity.

Keywords: students, obesity, genetic predisposition.

INTRODUCTION

Increasing life expectancy has led to an increase in the global burden of non-communicable diseases, which are the main cause of morbidity and mortality in the world. In this regard, in most developed countries more and more attention is paid to preventive personalized medicine, which is based in the individual management of health and body reserves in view of its genetic, physiologic, biochemical, metabolic or other individual characteristics.

The prospects of such an approach cannot be overestimated. Based on modern genetics achievements of molecular biology and bioengineering, it enables the use of high technologies (such as genetic testing, the study of biomarker molecules, etc.). Not only to identify the pathological processes in the pre-clinical stage of the disease, but also on the basis of an analysis of the data to predict a predisposition to certain diseases. However, the vast majority of chronic diseases (with the exception of monogenic) develop, provided the combination of genetic predisposition and environmental influences. Therefore, many genetic risks can never be realized over the life of the patient with the timely adoption of targeted measures aimed at preventing the disease.

It has long been recognized that genetics plays a key role in shaping the constitutional peculiarities of the organism. Genetic predisposition to excessive accumulation of body fat and obesity runs in families and is a multifactorial disease. To date more than 250 studied the role of genes in the development of obesity: leptin mutations in genes, leptin receptor, hormone convertase 1 precursor, proopiomelanocortin, melanocortin-4 receptor, and SIM 1. These studies help understand the molecular mechanisms that regulate energy balance in humans. However, genotyping at loci associated with impaired fat metabolism, at the level of primary health care is irrational from an economic point of view. Therefore, a search for markers of genetic susceptibility to obesity, the use of which would be low-cost, fast and efficient for screening the population surveys in order to identify individuals at high risk for developing the disease.

In genetic studies, widely used test of taste sensitivity to phenylthiocarbamide (FTC). Allelic TAS2R38 gene whose chief locus located on chromosome 7q35-36, while the additional - on chromosome 16p (Drayna, 2003; Adler, 2000; Reed, 2000) and a configuration control G-protein receptors are expressed in the language of the gastrointestinal tract and central nervous systems (Wu, 2002; Hao, 2008), and define the inherited ability or inability to feeling the bitter taste of the FTC and the related class of compounds.

Sensitivity to the FTC study non-invasive, does not require significant financial cost, is fast and allows a short time to obtain information about the state of the genotype of the subject.

Therefore, the establishment of the sensitivity of the status of the association to the FTC with a hereditary predisposition to obesity in young people and the clinical features of disease would be possible to organize screening

events in order to select the contingent for the primary prevention programs, as well as forecast for already developed the disease and assist in the selection of treatment tactics. In this context, the aim of the research was to study the genetic characteristics of obesity in young people in order to predict the predisposition of its development and trends.

MATERIALS AND METHODS

The basis of determining the sensitivity of the method was taken to phenylthiocarbamide, developed in 1949 by Harris and Kalmus. In 100 ml of distilled water was dissolved FTC mass weighed 260 mg. It turns out the starting solution (dilution 0), each subsequent dilution is reduced by half. Thus, we used a series of 14 dilutions in progression FTC 2.6 g per 1 liter of distilled water with the presentation of the subject in order from the smallest value of n (0,08 mg / l) until a clear sense of bitterness. The subject is asked to put on the area of the tongue strip of filter paper that has been soaked in a solution of a known concentration of FTC, thus determining their individual ability or inability to feel the bitter taste of the FTC: FTC + or FTK-.

Each trial began with the use of the solution with the lowest concentration of the drug phenylthiocarbamide. In the case where the subjects confirmed that taste feel to verify their sensations they were asked to make one more sample (next to increase concentration). Upon confirmation of a positive result, the fixed number of previous breeding.

For this study were selected 339 healthy people aged between 17 and 29 years enrolled in VSMU residents of the Central Black Earth region of Russia.

RESULTS

data distribution sensitivity analysis to the FTC in the group of healthy subjects "Non-testers" are 54 people (42.5%), "testers" – 73 persons (57.5%), while "absolute non-testers" are 7% of the surveyed – 51 people (40.1%), and hypersensitive to the MTF (conscious of the bitter taste in dilutions from 10 to 14) are 22 persons (17.3%). With an average level of sensitivity in the group corresponding to the threshold value "testers", men have a higher threshold of sensitivity to the FTC, in they feel the taste of the FTC in higher concentrations compared with women with the level difference is statistically significant – table 1.

Table 1. Average thresholds of sensitivity to the FTC in a group of clinically healthy persons based on gender

Gender	Sensitivity average value to the FTC
Men (n = 42)	3.8 ± 0.5
Women (n = 85)	6.2 ± 0.4 *
In the total sample (n = 127)	5.4 ± 0.4

* - $p = 0.001$ compared to men

These comparative analysis of anthropometric indices in the group of healthy persons showed that the «non-testers» differ significantly large values of height and weight in comparison with the «testers», and there was a trend to higher values of body mass index from the «non-testers», although the difference in this indicator between sub-groups did not reach a statistically significant level – table 2.

Table 2. Mean values of anthropometric parameters of clinically healthy individuals, depending on the sensitivity of the status to the FTC

Indicators	Health n = 127	Healthy "testers" n = 73	Healthy "non-testers" n = 54
Height (cm)	170.81 ± 0.79	169.38 ± 0.92	172.74 ± 1.33 *
Weight (kg)	63.81 ± 1.18	60.66 ± 1.20	68.06 ± 2.12 *
BMI (kg / m ²)	21.75 ± 0.30	21.06 ± 0.31	22.69 ± 0.55

* - $p < 0.05$

Comparative analysis of the frequency of overweight and obesity in a group of healthy persons showed that overweight is more common among subjects «non-testers» in comparison with «testers», 1 degree of obesity was noted only among the «non-testers.» Obesity Cases 2 and 3 degrees among clinically healthy individuals revealed was not – table 3.

Table 3. The frequency of overweight and obesity in a group of healthy subjects, depending on the sensitivity to the status of the MTF

Disease	Healthy n = 127		Healthy “testers” n = 73		Healthy “non-testers” n = 54	
	Abs. (Pers.)	Rel. (%)	Abs. (Pers.)	Rel. (%)	Abs. (Pers.)	Rel. (%)
Overweight	16	12.6	5	6.8	11	20.3
Obesity 1 degree	4	3.1	0	0	4	7.4

Results of the analysis of obesity anthropometric parameters are shown in table 4.

Table 4. Anthropometric parameters of obese patients

Indicator	Obese patients n = 51	Obese patients “testers” n = 27	Obese patients “non-testers” n = 24
Height (cm)	167.2 ± 1.2	167.4 ± 1.7	167.0 ± 1.8
Weight (kg)	77.9 ± 2.3	76.3 ± 2.6	79.6 ± 4.0
BMI (kg / m ²)	28.7 ± 0.8	27.3 ± 0.9	30.2 ± 1.4 *

* - p <0.05 as compared to the «testers»

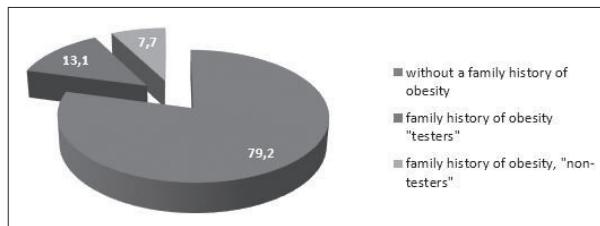
As can be seen from the data, the average BMI «non-testers» corresponds to obesity I degree and higher than for «testers» and the average value in the total group of patients with obesity, relevant overweight.

Analysis of the frequency of excess weight in obese patients according to table 5 also confirms a high prevalence of overweight in “testers” and the highest number of patients with obesity 1 degree among the “non-testers.” Please note that the obesity grade 3 patients identified only among the “non-testers.”

Table 5. Obesity and overweight rate in obese patients, depending on the sensitivity of the status to the FTC

Disease	Patients with obesity n = 51		Patients with obesity “testers” n = 27		Patients with obesity “non-testers” n = 24	
	Abs. (Pers.)	Rel. (%)	Abs. (Pers.)	Rel. (%)	Abs. (Pers.)	Rel. (%)
Overweight	16	31.4	11	40.7	5	20.8
Obesity 1 degree	8	7.4	6	15.7	2	25.0
Obesity 2 degree	6	11.8	3	11.1	3	12.5
Obesity 3 degree	2	3.9	0	0	2	8.3

In the analysis of the relation “testers” and “non-testers” in the study groups (Fig. 1) found that their distribution in the group of healthy corresponds to the literature data for Caucasian individuals with predominance of “testers” of “non-testers.” And in the group of obese patients observed distribution of inversion: the share of “non-sensitive” exceeds the percentage taste the FTC. Thus, it can be assumed that the status of insensitivity to FTC risk associated with obesity. In the study of family history in patients who are obese, being overweight and obesity in first-degree relative was found in 27 cases (20.8%), 10 of them are “testers” and 17 “non-testers.” The percentage of patients with a family history of obesity, is shown in Figure 1.

Fig. 1. Prevalence of family history of obesity in a group of obese patients, depending on the sensitivity of the status to the FTC

From the data presented in the figure can be seen that among patients with a family history of obesity, the proportion of “non-testers” almost twice as high as “testers”.

Comorbidities of patients in the group with obesity were observed in 70% of cases (36). The structure and the frequency of occurrence of comorbidity presented in – tab. 6.

Table 6. The frequency of co-morbidities in obese patients

Disease	Patients with obesity n = 51		Patients with obesity “testers” n = 27		Patients with obesity “non-testers” n = 24	
	Abs. (pers.)	Rel. (%)	Abs. (pers.)	Rel. (%)	Abs. (pers.)	Rel. (%)
Hypertensive heart disease	23	45	10	37	13	54
Diabetes mellitus type 2	5	9.8	3	11.1	2	8.3
CHD angina FC 1-2 June	6	12	3	11.1	3	12.5
Chronic pancreatitis	2	4	1	3.7	1	4.1
Chronic cholecystitis	2	4	1	3.7	1	4.1
Urolithiasis, pyelonephritis	4	7.8	4	15	0	0
Osteoarthritis	2	4	1	3.7	1	4.1

As can be seen from the data, the subgroup “testers” and “non-testers” comorbidity comparable in frequency, but all cases of urolithiasis and pyelonephritis account only the “testers”, and hypertensive disease is slightly more common in “non-testers.”

These subjective assessment of the overall health of the patient, the effect of existing conditions in the physical, mental capacity, ability for social interaction and the overall level of mental health in accordance with the SF-36 questionnaire are presented in tab. 7.

Table 7. Quality of life parameters on the SF-36 in patients with obesity

Index (Score)	Obese patients n = 51	Patients with obesity “testers” n = 27	Obese patients “non-testers” n = 24
GH	45.21 ± 1.74	41.67 ± 2.50	49.21 ± 2.17 *
PF	30.39 ± 3.52	31.67 ± 4.21	28.96 ± 5.88
RP	14.70 ± 4.44	14.81 ± 6.15	14.58 ± 6.54
RE	26.21 ± 5.71	19.85 ± 6.73	33.37 ± 9.41
SF	42.41 ± 1.82	42.85 ± 2.33	41.92 ± 2.89
BP	80.02 ± 4.17	79.67 ± 5.63	80.42 ± 6.32
VT	42.65 ± 2.29	42.96 ± 2.56	42.29 ± 4.00
MH	54.58 ± 2.47	54.81 ± 3.08	54.33 ± 4.01

* - p <0.05

As can be seen from the data, significant differences between the subgroups of «testers» and «non-testers» on the scale of quality of life questionnaire SF-36 is also not revealed, except the indicator of GH, which characterizes the general level of health. Using this parameter «non-testers» show a higher score indicating a better state of health.

CONCLUSION

Taste sensitivity test to the FTC is an affordable and quick way to diagnose a predisposition to excessive accumulation of body fat in young adults, which can be used at the level of primary health care to identify individuals increased risk of developing obesity to develop individual prevention programs. The study also taste sensitivity to FTC can help in predicting the course of the disease and the effect of traditional therapy.

The practical implementation of research results is not only medical, but also social and economic importance, since the use to create an effective model of forecasting and early diagnosis of obesity in young people, will prevent development of the disease and its associated conditions, reduce morbidity, healthcare costs for treatment and maintenance this category of the population, improve the quality of life of patients and maintain the ability to work.

The results can be used in medical practice for current and future planning cross-sectoral, sectoral and regional youth health programs based on the rational allocation of health care resources, as well as the justification of the investment policy in the social sphere and in health care.

LITERATURA / REFERENCES

- Adler, E., Hoon, M. A., Mueller, K. L., Chandrashekhar, J., Ryba, N. J., & Zuker, C. S. (2000). A novel family of mammalian taste receptors. *Cell*, 100(6), 693-702.
- Drayna, D., Coon, H., Kim, U. K., Elsner, T., Cromer, K., Otterud, B., ... & Leppert, M. (2003). Genetic analysis of a complex trait in the Utah Genetic Reference Project: a major locus for PTC taste ability on chromosome 7q and a secondary locus on chromosome 16p. *Human genetics*, 112(5-6), 567-572.
- Hao, S., Sternini, C., & Raybould, H. E. (2008). Role of CCK1 and Y2 receptors in activation of hindbrain neurons induced by intragastric administration of bitter taste receptor ligands. *American Journal of Physiology-Regulatory, Integrative and Comparative Physiology*, 294(1), R33-R38.
- Reed, D. R. (2000). Gene mapping for taste related phenotypes in humans and mice. *Appetite*, 35(2), 189-190.
- Rychkov, Y. G., & Borodina, S. R. (1973). Further investigations of the genetics of hypersensitivity to phenylthiocarbamide in man (experimental, population, and familial data). *Genetika*, 9, 141-152.
- Wu, S. V., Rozengurt, N., Yang, M., Young, S. H., Sinnott-Smith, J., & Rozengurt, E. (2002). Expression of bitter taste receptors of the T2R family in the gastrointestinal tract and enteroendocrine STC-1 cells. *Proceedings of the National Academy of Sciences*, 99(4), 2392-2397.

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RELACIJE MOTORIČKIH SPOSOBNOSTI I TEHNIČKO- TAKTIČKIH KARAKTERISTIKA STOLNOTENISAČA

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Sažetak: Ovo istraživanje je provedeno s ciljem utvrđivanja relacija između motoričkih sposobnosti i tehničko-taktičkih karakteristika stolnotenisača. Istraživanje je provedeno na uzorku od 48 najboljih seniora uzrasta od 18-36 godina (reprezentativni uzorak) u Bosni i Hercegovini. U tu svrhu primjenjen je sustav od (12) varijabli za procjenu bazičnih motoričkih sposobnosti, i (8) varijabli za procjenu tehničko-taktičkih karakteristika stolnotenisača. U cilju utvrđivanja relacija između bazičnih motoričkih sposobnosti i tehničko-taktičkih karakteristika stolnotenisača primjenjena je metoda kanoničke korelacijske analize. Dovođenjem u vezu ova dva prostora rezultiralo je izdvajanjem jednog kanoničkog faktora koji je statistički značajan. Najrelevantnije informacije za izdvojenu kanoničku komponentu daju koeficijenti strukture i kros-strukture. Koeficijenti strukture reprezentiraju korelacije izvornih varijabli s kanoničkom komponentom dobivenom iz skupa varijabli kome ta varijabla izvorno pripada, dok koeficijenti kros-strukture daju korelacije odgovarajuće izvorne varijable s kanoničkom komponentom koja je nastala u drugom setu varijabli. Na izoliranu kanoničku funkciju najveći značaj imaju varijable taping rukom, bacanje medicinice 1kg forhendom, dohvati u sijedu, skok u dalj s mjesta, dok također nešto manji značaj pokazuju druge varijable, ali iz istih prostora bazičnih motoričkih sposobnosti. Temeljem koeficijenata strukture može se rezimirati da sve tehničko-taktičke karakteristike visoko koreliraju sa čimbenikom izdvojenim iz ovog prostora što je i logično jer sve manifestne varijable predstavljaju jedan prostor (tehničko umijeće/vještina igranja). Varijable koje su vezane za fazu napada (inicijativa u poenu) i elemenata kretanja u igri (sigurnost i učinkovitost u napadačkoj igri iznad stola, sigurnost i učinkovitost prvog ulaza, učinkovitost kretanja u igri) značajnije su povezane s kanoničkim čimbenikom izdvojenim u prostoru motoričkih sposobnosti. Navedene varijable opisuju tehničke struk-

RELATIONS BETWEEN MOTOR ABILITIES AND TECHNICAL AND TACTICAL CHARACTERISTICS OF TABLE TENNIS PLAYERS

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Abstract: This study was conducted with aim to determine the relations between motor skills and technical and tactical characteristics of table tennis players. The study was conducted on a sample of 48 of the best seniors with aged 18-36 years old (a representative sample) in Bosnia and Herzegovina. For this purpose was applied the system of (12) variables to estimate the basic motor skills, and (8) variables for evaluation of technical and tactical characteristics of table tennis players. In order to determine the relations between the basic motor skills and technical and tactical characteristics of table tennis players, the method applied was the method of canonical correlation analysis. Establishing the link between these two areas resulted in the separation of one canonical factor which was statistically significant. The most significant information for extracted canonical component gives the coefficients of the structure and the cross-structure. The coefficients of the structure represent the correlations of the original variables with canonical component derived from a set of variables to which this variable originally belongs, while coefficients of cross- structure provide correlations of adequate source variables with canonical component that was created in other set of variables. Onto the isolated canonical function the most significant influence have the variables of hand tapping, throwing a medicine 1kg ball by forearm, boom in gray, long jump from the place, while also slightly smaller significance show other variables, but from the same subspaces of basic motor abilities. Based on the coefficients of the structure can be summarized that all the technical and tactical characteristics highly correlate with the factor isolated from this area which is logical, because all manifest variables represent one area (technical skills / playing skill). The variables that are related to the attack phase (initiative in points) and elements of game movement (the safety and effectiveness of the attack over the table, safety and efficacy of the first entrance, efficiency of game movement) are significantly associated with canonical factor isolated in the area of motor abili-

ture u kojima se „nameće“ i održava inicijativa u poenu, a predstavljaju najagresivije napadačke tehnike te u pravilu traže najveći motorički angažman. Stoga nije nikakvo iznenađenje što su upravo ove varijable tehničko-taktičke strukture najznačajnije povezane s čimbenikom izdvojenim u prostoru motoričkih sposobnosti.

Ključne riječi: stolnotenisaci, motoričke sposobnosti, tehničko-taktičke karakteristike, kanonička korelacijska analiza.

Uvod

Suvremena stolnoteniska igra se karakterizira brzinom segmentarnih pokreta (ekstremiteta), eksplozivnom snagom, brzinom reakcije udarca uz optimalno savladavanje (poznavanje) rotacije loptice koja u velikoj mjeri utječe na samu izvedbu pojedinih udaraca-topspin elemenata u cijelom prostoru igre (Kondrić, Hudetz, Koščak, Slatinšek, i Cerar, 2007). Brzina i spin su dva ključna elementa modernog sporta koji se igra s reketom. Brzina loptice je relativno vidljiva i od strane samog gledatelja, ali rotaciju loptice ili spin nije lako detektirati (Chiu i Tu, 2006).

Stolni tenis je kroz povijest iznimno napredovao, igra se ubrzala, poeni su brži a udarci snažniji i precizniji. Složenost izvođenja pojedinih tehničko-taktičkih elemenata i veliki raspon udaraca traži od igrača maksimalnu fizičku i psihičku pripremu (Fei, i sur. 2010).

Složenost stolnoteniskog sporta dovela je do perfekcije pojedine tehničko-taktičke postavke u igri, te samim tim i pojedini stolnoteniski profili igrača imaju važnu ulogu u postizanju što boljeg rezultata u ovom dinamičnom sportu. Specifičnost stolnoteniske igre dovela je do toga da stolnotenisaci za razliku od drugih sportaša pokazuju u prostoru motorike veću fleksibilnost, superiornost u eksplozivnoj snazi, bržu frekvenciju pokreta, agilnosti, superiornost u situacijskoj preciznosti, (Đokić, 2007).

Ovo istraživanje će doprinijeti boljem razumjevanju pojedinih sustava stolnoteniske igre te omogućiti dobivanje važnih saznanja o relacijama motoričkih sposobnosti i tehničko-taktičkih karakteristika stolnotenisaca. Ovim istraživanjem će se pokušati definirati određeni tehničko-taktički profili igrača s obzirom na njihove motoričke sposobnosti i tehničko-taktičke karakteristike.

Osnovni cilj ovog istraživanja je utvrđivanje relacija između motoričkih sposobnosti i tehničko-taktičkih karakteristika stolnotenisaca.

ties. These variables describe technical structures in which “imposes” and maintains the initiative in the point, and are the most aggressive attack techniques, and generally seek the largest motor engagement. No surprises then that exactly these variables of technical and tactical structures are significantly associated with the factor isolated in the area of motor abilities are the most important.

Keywords: table tennis players, motor abilities, technical and tactical characteristics, canonical correlation analysis.

INTRODUCTION

Contemporary table tennis game is characterized by speed of segmented movements (limbs), explosive strength, speed reaction of the hit/impact with the optimal overcoming (the knowledge) the rotation of the ball, which largely affects the very performance of individual hits- topspin elements in the entire game area (Kondrić, Hudetz, Koščak, Slatinšek, & Cerar, 2007). Speed and spin are the two key elements of modern sport that is played with a racquet. Speed of the ball is relatively visible by the viewer himself, but the rotation of the ball or the spin is not easy to detect (Chiu & Tu, 2006).

Throughout the history table tennis has extremely advanced, the game speeded up, points are faster and hits stronger and more precise. The complexity of the performance of individual technical and tactical elements and a wide range of strikes require of players maximum physical and mental preparation (Fei, et al., 2010).

The complexity of the table tennis sport led to the perfection of the individual technical and tactical settings in the game, and thus the individual profiles of table tennis players play an important role in achieving the best results in this dynamic sport. Specificity of the table tennis game led to the fact that table tennis players, unlike other athletes, show in the area of kinesiology greater flexibility, superiority in explosive strength, faster movement frequency, agility, superiority in the situation precision, (Djokic, 2007).

This research will contribute to a better understanding of individual table tennis systems of the game, and provide the relevant information on relations of motor skills and technical and tactical characteristics of table tennis players. This research will try to define certain technical and tactical player profiles considering their motor skills and technical and tactical characteristics.

The main goal of this research is to determine the relation between motor skills and technical and tactical characteristics of table tennis players.

METODOLOGIJA ISTRAŽIVANJA

Uzorak ispitanika

Uzorak ispitanika čini 48 najboljih seniora uzrasta od 18-36 god. (reprezentativni uzorak) u Bosni i Hercegovini. Uzorak ispitanika je odabran temeljem kvalifikacijskog turnira svih registriranih stolnotenisača Bosne i Hercegovine. Najboljih 48 stolnotenisača s kvalifikacijama izborili sudjelovanje na državnom prvenstvu.

Uzorak varijabli

Varijable motoričkih sposobnosti

Za procjenu bazičnih motoričkih sposobnosti upotrijebljeni su standardizirani testovi (Mikić, 2000; Ahmetović, 1987). Testovi su kroz dosadašnja istraživanja pokazali zadovoljavajuće metrijske karakteristike.

Procijenjene su sledeće motoričke sposobnosti: eksplozivna snaga, repetitivna snaga, koordinacija-agilnost, brzina frekvencije pokreta i fleksibilnost

Za procjenu eksplozivne snage primjenjeni su sljedeći testovi:

1. (MFESDM) – skok u dalj s mjesta
2. (MFE20V) – trčanje iz visokog starta na 20 metara
3. (MESFOR) – bacanje medicinke 1kg imitacijom forend tehnike*
4. (MFEBML) – bacanje medicinke iz ležanja na leđima

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Za procjenu repetitivne snage primjenjeni su sljedeći testovi:

1. (MRCDLC) – ležanje – sijed za 30 s
2. (MRCIST) – ispravljanje trupa

Za procjenu koordinacije – agilnosti primjenjeni su sljedeći testovi:

1. (MAGTUP) – trčanje u pravokutniku – koverta test
2. (MAGKUS) – koraci u stranu

Za procjenu brzine frekvencije pokreta primjenjeni su sljedeći testovi:

1. (MBFTAP) – taping rukom
2. (MBFTAN) – taping nogom

Za procjenu fleksibilnosti primjenjeni su sljedeći testovi:

1. (MFLDSI) – dohvati u sjedu
2. (MFLISK) – iskret s palicom

Varijable za procjenu tehničko-taktičkih karakteristika igrača

Ove varijable su odabrane temeljem rezultata dosadašnjih znanstvenih istraživanja te na teoretskim (stručna stolnoteniska literatura) i empirijskim znanjima vezanim uz karakteristike stolnoteniskog sporta, (Đokić, 2001; Munivrana, 2011), koji su doprinijeli rješavanju tehničko-taktičkih zahtjeva same igre.

RESEARCH METHODOLOGY

Pattern of respondents

Pattern of respondents was made of 48 best seniors aged from 18-36 years old (representative sample) in Bosnia and Herzegovina. The sample respondents were selected based on Qualifications tournament of all registered table tennis players in Bosnia and Herzegovina. The top 48 table tennis players from qualification have won to participate in National Championship.

Pattern of variables

Motor skills variables

For the evaluation of basic motor skills were used standardized tests (Mikic, 2000; Ahmetovic, 1987). Tests, through previous studies have shown satisfactory metric characteristics/properties.

The following motor skills were evaluated: explosive strength, repetitive strength, coordination – agility, speed of movement frequency and flexibility.

For the assessment of explosive strength following tests were applied:

1. (MFESDM) - long jump with places
2. (MFE20V) - running from a standing start to 20 meters
3. (MESFOR) - 1kg medicine ball toss imitating the forehand technique *
4. (MFEBML) - throwing a medicine ball from lying on the back

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For the assessment of repetitive strength the following tests were applied:

1. (MRCDLC) - Lying – sitting for 30 seconds
2. (MRCIST) – lifting the trunk

For the assessment of coordination - agility the following tests were applied:

1. (MAGTUP) - running in a rectangle - envelope test
2. (MAGKUS) - side steps

For the assessment of speed movement frequency the following tests were applied:

1. (MBFTAP) - hand tapping
2. (MBFTAN) - foot tapping

For the assessment of flexibility the following tests were applied:

1. (MFLDSI) - reach while sitting
2. (MFLISK) – twist with the handle

The variables to assess the technical and tactical characteristics of players

These variables were selected based on the results of previous scientific research and the theoretical (professional table tennis literature) and empirical knowledge concerning the characteristics of table tennis sport (Đjokic,

Za procjenu tehničko-taktičkih karakteristika igrača primjenjene su sljedeće varijable:

- **Faza pripreme vlastitog i onemogućavanje protivničkog napada** (protivniku se nastoji onemogućiti stjecanje incijative u poenu te se nastoji ostvariti vlastita napadačka prednost).
- 1. (EFSERV) - Učinkovitost servisa
- 2. (EFOPIO) - Učinkovitost u onemogućavanju protivničkog i pripremi vlastitog napada
- **Faza napada** (igrač prvi ulazi i ima iniciativu u poenu)
 1. (SIEFNA) - Sigurnost i učinkovitost u napadačkoj igri iznad stola
 2. (SIEFP) - Sigurnost i učinkovitost prvog ulaza
 3. (EFKONA) - Učinkovitost u kontinuiranoj napadačkoj aktivnosti
- **Faza obrane** (igra u fazi kada je protivnik prvi ostvario iniciativu u poenu)
 1. (EFPAOB) - Učinkovitost u pasivnoj obrani
 2. (EFAOBR) - Učinkovitost u aktivnoj obrani
- **Elementi kretanja** (sve vrste kretanja u igri)
 1. (EFKREI) - Učinkovitost kretanja u igri

Metode obrade podataka

Relacije između istraživanih prostora utvrđene su kanoničkom korelacijskom analizom. U skladu s ovom metodom izračunate su vrijednosti: koeficijent kanoničke korelacije između dva niza kanoničkih varijabli R, njima pripadajući koeficijent determinacije (R^2) vrijednosti HI-kvadrat testa (H_2) stupnjeva slobode (DF) i vjerojatnost javljanja pogreške zaključivanja (P).

REZULTATI I DISKUSIJA

Relacije motoričkih sposobnosti – tehničko-taktičkih karakteristike stolnotenisaca

U ovom istraživanju prostor tehničko-taktičkih karakteristika stolnotenisaca reflektiran je preko 8 varijabli koje operacionaliziraju prostor tehničko-taktičkih karakteristika (učinkovitost servisa, učinkovitost u onemogućavanju protivničkog i pripremi vlastitog napada, sigurnost i učinkovitost u napadačkoj igri iznad stola, sigurnost i učinkovitost prvog ulaza, učinkovitost u kontinuiranoj napadačkoj aktivnosti, učinkovitost u pasivnoj obrani, učinkovitost u aktivnoj obrani, učinkovitost kretanja u igri). Prostor bazičnih motoričkih sposobnosti stolnotenisaca obuhvatio je 12 varijabli.

Operacionalizacija motoričkih sposobnosti izvršena je posredstvom 12 sljedećih varijabli: skok u dalj s mjesta, trčanje iz visokog starta na 20 metara, bacanje

2001 Munivrana, 2011), which contributed to solving the technical and tactical demands of the game itself.

For the assessment of the technical and tactical characteristics of players the following variables were applied:

- **The preparation phase of their own and disabling opponent attack** (you endeavor to prevent the opponents' achieving in points and trying to achieve its own offensive advantage).
- 1. (EFSERV) - The efficiency of service
- 2. (EFOPIO) - The effectiveness in preventing the opponents' attack and in preparation of your own attacks
- **Phase of the attack** (player first enters and owns the initiative in points)
- 1. (SIEFNA) - Sureness and effectiveness in attacking game over the table
- 2. (SIEFP) - Sureness and efficacy of the first entrance
- 3. (EFKONA) - Efficiency in continuous attack activity
- **Phase of the defense** (game at the stage when the opponent has first achieved the initiative in points)
- 1. (EFPAOB) - The effectiveness of the passive defense
- 2. (EFAOBR) - The effectiveness of the active defense
- **The elements of movement** (all kinds of movement in the game)
- 1. (EFKREI) - The efficiency of movement in the game

Methods for data analysis

Relations between the studied areas were determined by canonical correlation analysis. In accordance with this method these values were calculated: coefficient of canonical correlation between the two lines of canonical variables R, accompanying coefficient of determination (R^2) value of HI-square test (H_2), degrees of freedom (DF) and the probability of conclusion mistake occurrence (P).

RESULTS AND DISCUSSION

Relations of motor skills - technical and tactical characteristics of table tennis players

In this research area of technical and tactical characteristics of table tennis players is reflected through 8 variables that operate the area of technical and tactical characteristics (efficiency of service, efficiency in preventing the opponents' attack and the preparation of your own attacks, sureness and efficiency in the attacking game over the table, the sureness and efficacy of the first entrance, efficiency in continuous attack activities, the effectiveness of the passive defensive, efficiency in active defense, efficiency of game movement). Area of basic motor abilities of table tennis players included 12 variables.

Operating the motor skills was carried out through 12 following variables: long jump with places, running

medicinke 1kg imitacijom forhend tehnike, bacanje medicinke iz ležanja na ledima, ležanje-sijed za 30 sekundi, ispravljanje trupa, trčanje u pravokutniku, koraci u stranu, taping rukom, taping nogom, dohvati u sijedu, iskret s palicom.

Dovođenjem u vezu ova dva prostora rezultiralo je izdvajanjem jednog kanoničkog faktora koji je statistički značajan. Relacije između tehničko-taktičkih karakteristika stolnotenisača i motoričkih sposobnosti prikazane su u (*Tablici 1.*).

Tablica 1. Kanoničke korelacije i testovi značajnosti za varijable iz skupa tehničko-taktičke karakteristike i motoričke sposobnosti stolnotenisača / **Table 1.** Canonical correlation and tests significant for the variables from a set of technical and tactical characteristics and motor skills of table tennis players

	P	ρ^2	F-test	df1	df2	p
1	.75	.56	58.36	2	46	.000

ρ = kanonička korelacija, ρ^2 = koeficijent kvazikanoničke determinacije /

ρ = canonical correlation, ρ^2 = coefficient of canonical determination

Magnituda kanoničke korelacije iznosi $\rho=.75$ što znači da izolovani čimbenik obuhvaća oko 56% kanoničke varijance ova dva skupa varijabli.

Za smislenu interpretaciju relevantni su kanonički koeficijenti koji predstavljaju pondere kojima se moltipliciraju izvorne varijable kako bi se formirala odgovarajuća kanonička komponenta, no najrelevantnije informacije daju koeficijenti strukture i kros-strukture (*Tablica 2.*). Koeficijenti strukture reprezentiraju korelacije izvornih varijabli s kanoničkom komponentom dobivenom iz skupa varijabli kome ta varijabla izvorno pripada, dok koeficijenti kros-strukture daju korelacije odgovarajuće izvorne varijable s kanoničkom komponentom koja je nastala u drugom setu varijabli. Koeficijenti sklopa nisu analizirani jer se radi o slučaju samo s jednim izdvojenim čimbenikom.

from a standing start to 20 meters, throwing 1kg medicine ball imitating forehand technique, throwing a medicine ball from lying on the back, lying-sitting for 30 seconds, lifting the trunk, running in rectangle, side steps, hand tapping, foot tapping, reach while sitting, twist with the handle.

Establishing the link between these two areas resulted with the separation of one canonical factor that is statistically significant. Relations between technical and tactical characteristics of the table tennis players and motor skills are shown in (*Table 1.*).

The magnitude of the canonical correlation is $\rho = .75$, which means that an isolated factor comprises about 56% of canonical variance of these two sets of variables.

For a meaningful interpretation of the relevant canonical coefficients representing ponders which multiply the original variables in order to form a corresponding canonical component, but the most relevant information provide structure and cross-structure coefficients. (*Table 2.*) The coefficients of structure represent the correlations of the original variables with canonical component derived from a set of variables to which this variable originally belongs, while coefficients of cross-structure provide correlations of adequate source variable with canonical component that was created in the other set of variables. The coefficients of the set were not analyzed because it is a case of just one isolated factor.

Tablica 2. Kanonički koeficijenti, struktura i kros-struktura tehničko-taktičkih karakteristika na izdvojeni kanonički faktor / **Table 2.** Canonical coefficients, structure and cross-structure of technical and tactical characteristics onto the isolated canonical factor

	Kanonički koeficijenti / Canonical coefficients	Koeficijenti Strukture / Structure coefficients	Koeficijenti kros-strukture / Cross-structure coefficients
Učinkovitost servisa / The efficiency of service	-.319	-.801	-.525
Onemog protiv.nap. / Disabling the op.attack	-.333	-.830	-.548
Učink.napad.igre / The effic. of att.game	-.417	-.870	-.687
Sigurnost prvog ulaza / Sureness of fr.entrance	-.438	-.885	-.721
Kontinuirani napad / Continuous attack	-.314	-.702	-.518
Pasivna odbrana / Passive defense	-.249	-.634	-.409
Aktivna odbrana / Active defense	-.296	-.765	-.488
Učinkovitost kretanja / The effic.of movement	-.416	-.757	-.686

Temeljem koeficijenata strukture može se rezimirati da sve tehničko-taktičke karakteristike visoko koreliraju sa čimbenikom izdvojenim iz ovog prostora što je i logično jer sve manifestne varijable predstavljaju jedan prostor (tehničko umijeće/vještina igranja). Varijable koje su vezane za fazu napada (inicijativa u poenu) i elemenata kretanja u igri (sigurnost i učinkovitost u napadačkoj igri iznad stola, sigurnost i učinkovitost prvog ulaza, učinkovitost kretanja u igri) značajnije su povezane s kanoničkim čimbenikom izdvojenim u prostoru motoričkih sposobnosti.

Navedene varijable opisuju tehničke strukture u kojima se „nameće“ i održava inicijativa u poenu, a predstavljaju najagresivnije napadačke tehnike te u pravilu traže najveći motorički angažman. Stoga nije nikakvo iznenadenje što su upravo ove varijable tehničko-taktičke strukture najznačajnije povezane s čimbenikom izdvojenim u prostoru motoričkih sposobnosti.

Based on the coefficients of the structure, we can summarize that all the technical and tactical characteristics highly correlate with the factor isolated from this area which is logical because all manifest variables represent one area (technical skills / skill of the game). The variables that are related to the attack phase (initiatives in points) and elements of movement in the game (sureness and effectiveness of the attack game over the table, sureness and efficacy of the first entrance, efficiency of movement in the game) are significantly associated with canonical factor isolated in the area of motor abilities.

These variables describe technical structures in which is “imposed” and maintained the initiative in the points, and represent the most aggressive attack techniques, and generally ask the largest motor engagement. No surprises then that exactly these variables of technical and tactical structures are significantly associated with the factor isolated in the area of motor abilities are the most important.

Tablica 3. Kanonički koeficijenti, struktura i kros-struktura motoričkih sposobnosti na izdvojeni kanonički čimbenik /
Table 3. Canonical coefficients, structure and cross-structure of motor abilities on isolated canonical factor

	kanonički koeficijenti / Canonical coefficients	Koeficijenti strukture / Structure coefficients	koeficijenti kros-strukture / Cross-structure coefficients
Lezanje-sijed 30 sec. / Lying-sitting 30 sec.	-.102	-.382	-.182
Ispravljanje trupa / Lifting the trunk	.054	.056	.091
Bac. med. 1kg.forhind / 1kg forehand med.ball toss	-.410	-.896	-.704
Dohvat u sijedu / Reach while sitting	-.407	-.817	-.700
Iskret s palicom / Twist with the handle	.046	.061	-.080
Taping rukom / Hand tapping	-.476	-.924	-.818
Taping nogom / Foot tapping	-.124	-.400	-.213
Koraci u stranu / Side steps	.329	.867	.564
Koverta test / Envelope test	.166	.413	.284
Skok u dalj s mjesta / Long jump with places	-.362	-.912	-.621
Sprint iz vis. st. 20m / Sprint run from a standing start to 20 meters	.200	.661	.344
Bacanje med. iz lež. / Med. ball toss while lying	-.318	-.659	-.546

Temeljem dobivenih rezultata može se zaključiti da varijable koje se odnose prije svega na eksplozivnu snagu, fleksibilnost i brzinu pojedinačnih pokreta, reflektiraju prostor motoričkih sposobnosti. Temeljem strukture kanoničkih faktora u prostoru bazičnih motoričkih sposobnosti (Tablica 3.), može se konstatirati da je značajan kanonički faktor mješovitog tipa a povezan je značajnije s prostorom tehničko-taktičkih karakteristika stolnotenisača. Zastupljen je pojedinačnim varijablama u tri potprostora (eksplozivne snage donjih ekstremiteta i ramenog pojasa, fleksibilnosti i brzine frekvencije pokreta rukom).

Based on the results, we can conclude that the variables related primarily to the explosive strength, flexibility and speed of individual movements reflect the area of motor abilities. Based on the structure of canonical factors in the area of basic motor skills (Table 3.), it can be concluded that is significant canonical factor of mixed type and is significantly associated with the area of technical and tactical characteristics of table tennis players. It is included with the individual variables in three subspaces (explosive strength of the lower extremities and shoulders, flexibility and frequency of hand movement).

Na izoliranu kanoničku funkciju najveći značaj imaju varijable taping rukom, bacanje medicinke 1kg forhendom, dohvati u sjedu, skok u dalj s mjesta, dok također nešto manji značaj pokazuju druge varijable, ali iz istih potprostora bazičnih motoričkih sposobnosti.

Kao ukupno gledano najznačajniji prediktor u analizama kojima je utvrđena povezanost motoričkih sposobnosti i tehničko-taktičke učinkovitosti stolnotenisača definirana je varijabla za procjenu frekvencije pokreta odnosno taping rukom. Ova varijabla značajni je prediktor u svim analizama što ustvari govori o visokoj vrijednosti frekvencije pokreta kao mjeru motoričkog statusa stolnotenisača.

Za ovu činjenicu može se izdvojiti nekoliko razloga, ali u prvom redu razlog sadržan je u tome što varijabla taping rukom, mada prvenstveno varijabla za procjenu frekvencije pokreta u sebi saturira jednu izuzetno važnu motoričku sposobnost u stolnom tenisu, a to je ustvari brzina jednostavnog pokreta. Stolni tenis je sport brzine (Kondrić, i sar. 2013).

Brzina frekvencije pokreta ruke važna je s aspekta tehničko-taktičkih karakteristika jer ukazuje na kvalitetu intermuskularne koordinacije (pravovremeno uključivanje agonističkih i antagonističkih mišićnih jedinica) koja je iznimno bitna za kvalitetno i precizno izvođenje različitih tehnika udarca u stolnom tenisu.

Varijabla taping rukom ustvari je sastavljena od većeg broja ponavljanja brzine jednostavnog pokreta, jasno je kako je upravo brzina jednostavnog pokreta mjeru koja sama po sebi definira pravu prirodu povezanosti između tapinga rukom i tehničko-taktičke učinkovitosti.

Ono što je međutim zanimljivo za primijetiti je da varijabla taping rukom saturira dvije brzine jednostavnog pokreta i to: brzinu jednostavnog pokreta u kretnji koja je definirana angažmanom prsne muskulature i muskulature prednje strane ramena (forhend kretnja), ali i kretnji jednostavnog pokreta koja je definirana angažmanom leđne i stražnje ramene muskulature (bekhend kretnja). Ovo daje jasnu sliku o stvarnoj prirodi povezanosti varijable taping rukom s tehničko-taktičkom uspješnošću stolnotenisača.

Druga varijabla koja je u većini slučajeva značajan prediktor u objašnjavanju tehničko-taktičke uspješnosti stolnotenisača jeste varijabla za procjenu eksplozivne snage ruku i ramenog pojasa. Snaga ruku je potrebna za brze i jake udarce, prvenstveno prilikom završnih udaraca, i ona se manifestira kao eksplozivna snaga. Eksplozivnu snagu u stolnoteniskoj igri može se promatrati kao sposobnost izvođenja brzih (eksplozivnih) pokreta uz konstantno opterećenje, na koju ne smije utjecati umor, a

On isolated canonical function most significant influence have variables like hand tapping, throwing a 1kg medicine ball by forehand, reach while sitting, long jump with places, while also slightly smaller significance show other variables, but from the same subspaces of basic motor abilities.

In overall picture the most significant predictor in the analysis that established the connection between motor skills and technical and tactical effectiveness of table tennis players defined a variable to assess the frequency of movement, or hand tapping. This variable is a significant predictor in all analyzes, that actually speaks about the high value of the motion frequency as a measurement for motor status of table tennis players.

In order to confirm this fact, can be allocated a number of reasons, but first reason is contained in the statement that a hand tapping variable, although primarily a variable to assess the frequency of movement, saturates a very important motor skill in table tennis and it is in fact speed of a simple movement. Table tennis is a sport of speed (Kondrić, et al. 2013).

Speed frequency of hand movement is important in terms of technical and tactical characteristics as it indicates the quality of intramuscular coordination (the timely included agonistic and antagonistic muscle units), which is extremely important for the quality and precise performance of various techniques of hits in table tennis.

Hand tapping variable is actually made up of a large number of repetitions of simple speed movements, it is clear that it is the speed of simple movement a measure which itself defines the true nature of the connection between hand tapping and technical efficiency.

However, what is interesting to note is that the hand tapping variable saturates the two speeds of simple movement, namely: the speed of simple movement in the motion that is defined engagement pectoral muscles and muscles of the front of the shoulder (forehand movement), but also the motion of simple movement that is defined by engagement of the back and back shoulder muscles (backhand motion). This gives a clear picture and the true nature of the connection between hand tapping variable and the technical and tactical successfulness of the table tennis players.

Another variable that is in most cases a significant predictor in explaining the technical and tactical performance of table tennis players is variable to assess explosive strength of arms and shoulders. The strength of arm is needed for quick and powerful hits, especially during the final strikes, and it manifests as an explosive strength. Explosive strength in table tennis game can be seen as the ability to perform fast (explosive) movements

čiji je cilj brzina poentiranja i svladavanje prostora u što kraćem vremenu (brza kretanja).

Eksplozivnost daje snagu udarca i mogućnost brzog starta u bilo kojem pravcu. Snaga mišića ramenog pojasa značajna je u velikoj mjeri za bolje performanse spin udaraca u stolnom tenisu. Snaga ruku i ramenog pojasa je potrebna za brze i jake udarce, prvenstveno prilikom završnih udaraca.

Kod izvođenja dinamičnih udaraca velika brzina reketa postiže se ako se ubrzavanje koristi stalno i progresivno uz pretpostavku da je suradnja mišićnih skupina uključenih u tijek pokreta ispravno koordinirana.

S aspekta izvođenja udaraca, forhend i behkend, udarce omogućavaju rotatori trupa, mišići ramenog pojasa i ruku, a sudjeluju mišići nogu i leđa. Igrač treba da razvije veliku snagu u brzim pokretima.

Relativan doprinos dvoglavnog mišića nadlaktice i velikog grudnog mišića je najvažniji kod udaraca, njihova uloga je da poveća snagu i jačinu udarca igrača. Dvoglavi mišić nadlaktice ima još značajniju ulogu u brzini forhenda. Osim toga, veliki leđni mišić je mišić koji se najviše koristi pri velikim brzinama loptice u stolnom tenisu.

Velik utjecaj na brzinu udarca ima eksplozivna snaga ruku, ramenog pojasa i trupa, ali taj utjecaj opada kod tehnički složenijih udaraca.

Snaga mišića nogu, naročito opružača zglobova kuka, koljena i skočnog zglobova, kao i odmicača nogu, uvjetuje sposobnost eksplozivnih skokova i brzih kretanja lijevo-desno, naprijed-natrag, veoma potrebnih stolnotenisaca-ma.

Fleksibilnost omogućuje stolnotenisacima elastičnu muskulaturu i mišićne pripone kao i pokretljive zglobove, koji igraču omogućuju brze prelaze iz jednog sustava igre u drugi, kao i promjene pravca kretanja pojedinih dijelova i cijelog tijela.

Jedna od temeljnih karakteristika fleksibilnosti je njezina specifičnost, tj. opseg pokreta je različit za svaki zglob, a fleksibilnost također ovisi i o pokretu (statika, dinamika).

Dinamička fleksibilnost predstavlja sposobnost izvođenja dinamičkih pokreta kroz puni opseg pokreta u određenom zglobu (npr. kod izvođenja servisa potrebna je fleksibilnost šake, brzina trzaja u zapešću i preciznost).

Stolnotenisaci se u velikoj mjeri stavlju u različite dinamičke situacije, što sa psihofizičkog stajališta rezultira kreiranjem velikog broja motoričkih programa potrebnih prilikom raznih akcija ili reakcija.

Za dobru tehniku izvođenja udaraca u stolnom tenisu potrebna je optimalna fleksibilnost.

with constant loading, that cannot be affected by fatigue and which aims to speed scoring and mastering the space as soon as possible (rapid movement).

Explosiveness gives the force of impact and the possibility of a fast start in any direction. The strength of the shoulder belt muscles is important to a large extent for the performance of spin strikes in table tennis. The strength of arms and shoulder belt is required for fast and powerful hits, especially during the final hits.

When performing dynamic strikes high racket speed is achieved if the acceleration is used constantly and progressively assuming the cooperation of muscle groups involved in the flow of movement properly coordinated.

In terms of execution strikes, forehand and backhand, strikes are allowed by torso rotators, shoulder and arm muscles, and also leg and back muscles participate. The player needs to develop a major force in the fast movements.

The relative contribution of the biceps brachii and pectoralis major is the most important during the strikes, their role is to increase the strength and intensity of player's hit. Biceps brachii has an even more significant role in the speed of forehand. In addition, the latissimus dorsi muscle is the muscle which is mainly used in high-speed balls in table tennis.

A big influence on the speed of strike has the explosive strength of arms, shoulder and torso, but that effect decreases with technically complex strikes.

The leg muscle strength, especially quadriceps, knee and ankle, and leg abductor, are conditioning the ability of explosive jumps and quick movements from side to side, back and forth, much needed for table tennis players.

Flexibility enables table tennis players elastic musculature and muscle annexes as well as movable joints that allow the player fast transitions from one game system to the other, as well as changes in direction of individual parts and the whole body.

One of the fundamental characteristics of flexibility is its specificity, ie. Range of motion is different for each joint, and flexibility also depends on the movement (statics, dynamics).

Dynamic flexibility represents the ability to perform dynamic movement through full range of motion in certain joints (eg. When performing services is required flexibility of the hands, twitch speed in the wrist and precision).

Table tennis players are largely placed in different dynamic situations, as with psychological and physical point of view results in creating a large number of motor programs necessary when performing various actions or reactions.

For a good technique of strikes in table tennis requires optimum flexibility.

Fleksibilnost ima presudnu ulogu u prevenciji i oporavku od ozljeda ili umora.

ZAKLJUČAK

Imajući u vidu složenost stolnoteniske igre može se konstatirati da se u tijeku stolnoteniskog meča odvija veliki broj tehničko-taktičkih akcija u kratkom razdoblju odlučivanja. Sigurno je da su za izvođenje ovako složenih tehničko-taktičkih radnji neophodne i adekvatne bazične motoričke sposobnosti. U stolnom tenisu, da bi se motorički potencijal pojedinca mogao u potpunosti izraziti, neophodno je posjedovati visoku razinu tehničke i taktičke obučenosti. Istraživanja u stolnom tenisu koja su se bavila ovom problematikom također naglašavaju važnost motoričkih varijabli u procjeni kvalitete u izvedbi tehničko-taktičkih elemenata stolnotenisača (Hsu i sur., 2010.; Kondrić, Zagatto, i Sekulić, 2013.; Raab, 2004).

Kanoničke korelacijske analize kojima se utvrđala povezanost motoričkih prediktora i tehničko-taktičke učinkovitosti stolnotenisača u pravilu su značajne. Međutim, očito je da su kanonički faktori s motoričkim prediktorima objasnile veći postotak varijance tehničko-taktičkih kriterija kod onih kriterija kod kojih je očito da se radi o mjerama koje su u određenoj mjeri definirane eksplozivnom snagom i agilnošću. Pri tome ne treba sumnjati kako su svi tehničko-taktički kriteriji u određenoj mjeri definirani bazičnim motoričkim sposobnostima, ali jasno je kako neke od tih kriterija, primjerice „učinkovitost kretanja u igri“ ili „učinkovitost u kontinuiranoj napadačkoj igri“ bitnije određuju eksplozivna snaga i agilnost nego neke druge kriterije, kao što je primjerice „učinkovitost servisa“. Motoričke sposobnosti su ustvari sposobnosti koje određuju potencijal osobe u izvođenju motoričkih manifestacija, to jest složenih i jednostavnih kretnji koje se izvode djelovanjem skeletnih mišića (Sekulić i Metikoš, 2007), pa samim tim je i za očekivati da ove sposobnosti budu značajniji prediktor onih tehničko-taktičkih elemenata koji su određeni potrebom za savladavanjem otpora u određenoj mjeri. Dobiveni rezultati ne iznenađuju, jer u tehnički iznimno složenom sportu kakav je stolni tenis, motoričke sposobnosti, iako nedvojbeno imaju velik utjecaj na izvođenje različitih tehničko-taktičkih struktura, nisu faktor koji izravno i isključivo utječe na te strukture (kao kod nekih strukturno jednostavnijih sportova, npr. monostrukturalnih).

To se potvrdilo i u ovome radu. Kada bi se definirala nekakva hijerarhijska struktura motoričkih sposobnosti koje su presudne za izvedbu tehničko-taktičkih elemenata stolnotenisača ispitivanih u istraživanju moglo bi se izdvojiti frekvenciju pokreta, eksplozivnu snagu, fleksibilnost...

Flexibility plays a crucial role in preventing and recovering from injury or fatigue.

CONCLUSION

Given the complexity of table tennis game, it can be said that in the course of table tennis match takes a large number of technical and tactical actions are performed in the short term of decision making. It is certain that for the performance of such complex technical and tactical actions are necessary and adequate basic motor skills. In table tennis, in order to fully express motor potential of individual, it is necessary to possess a high level of technical and tactical training. Research in table tennis that dealt with this issue also underline the importance of motor variables in assessing the quality of the performance of technical and tactical elements of table tennis players (Hsu et al., 2010; Kondrić, Zagatto & Sekulic, 2013; Raab, 2004).

Canonical correlation analysis which determined the connection between motor predictors and technical and tactical effectiveness of table tennis players are generally significant. However, it is obvious that the canonical factors with motor predictors explained the most of the variance of technical and tactical criteria for those criteria where it is obvious that these are measures that are to some extent defined by explosive strength and agility of the players. We should not doubt that all the technical and tactical criteria to some extent are defined by explosive strength and agility, but it is clear that some of these criteria, such as “efficiency of movement in the game” or “efficiency in continuous attack game” significantly determine the basic motor skills than any other criteria, such as “service efficiency”. Motor skills are actually skills that determine a person’s potential in performing the motor manifestations, that is complex and simple movements that are performed by acting of skeletal muscle (Sekulic & Metikoš, 2007), and therefore is to be expected that these skills are more important predictor of those technical and tactical elements which are determined by the need for overcoming resistance to some extent. The results are not surprising, because in technically very complex sport, as is table tennis, motor skills, although undoubtedly, have a great influence on the performance of different technical and tactical structures, are not a factor that directly and exclusively affects these structures (as in some structurally simpler sports, eg. of mono-structural).

This is also confirmed in this paper. If it's to define some kind of hierarchical structure of motor skills that are critical to the performance of technical and tactical elements of table tennis players tested in the study, we could extract the frequency of movement, explosive strength, flexibility...

Izjava autora
Autori pridonijeli jednako.
Konflikt interesa
Mi izjavljujemo da nemamo konflikt interesa

Author's statement
The authors contributed equally.
Conflict of interest
We declare that we have no conflict of interest

LITERATURA / REFERENCES

- Ahmetović, Z. (1987). *Testovi za utvrđivanje nivoa biomotoričkih sposobnosti sportista*. Novi Sad: Zavod za fizičku kulturu, Vojvodina. [In Serbian]
- Chiu, Y.-H., & Tu, J.-H., (2006). The measuring method for the spin axis and the rate of the rotational ball. *Journal of Physical Education in Higher Education*, 8(3), 139-147.
- Dokić, Z. (2001). Structure of competitors activities of top table tennis players. *Table tennis Sciences*, 4-5, 74-91.
- Dokić, Z. (2007). Functional diagnostics of top table tennis players. U M. Kondrić, & G. Furjan Mandić (Eds.), *Proceedings book of The 10th Anniversary ITTF Sports Science Congress* (str. 168 - 174). Zagreb: University of Zagreb, Faculty of kinesiology; Croatian Table Tennis Association; International Table Tennis Federation.
- Fei, Y., Ushiyama, Y., Jie, L., H., Lizuka, S., & Komijama, K. (2010). Analysis of the ball fall point in table tennis game. *International Journal of Table Tennis Sciences*, 6, 131-136.
- Hsu, Y.W.E., Tsai, C.L.A., Lu, J. H. F., & Tsai, F.C.N. (2010). The effectiveness of table tennis training on motor performance and visual perceptual ability in children with DCD. *Journal of Sport and Exercise Psychology*, 32, 86-87.
- Ivanek, V., Mikić, B., & Avdibašić-Vukadinović, N. (2010). Kanonička povezanost motoričkih i situaciono-motoričkih sposobnosti stolnotenisera kadetskog uzrasta. U D. Tomić, & M. Đukić, (Eds.), *Zbornik radova VI Međunarodne konferencije „Menadžment u sportu“*, (str.57-61). Beograd. Fakultet za menadžment u sportu "Alfa Univerzitet". [In Croatian]
- Kondrić, M., Hudetz, R., Koščak, J., Slatinšek, U., & Cerar, K. (2007). Research regarding possibilities of marking the ball in order to make spin visible. U M. Kondrić, & G. Furjan Mandić (Eds.), *Proceedings book of The 10th Anniversary ITTF Sports Science Congress* (str. 120 - 122). Zagreb: University of Zagreb, Faculty of kinesiology; Croatian Table Tennis Association; International Table Tennis Federation.
- Kondrić, M., Zagatto, A. M., & Sekulić, D. (2013). The Physiological Demands of Table Tennis: A Review. *Journal of Sports Science and Medicine*, 12(3), 362-370.
- Mikić, B. (2000). *Testiranje i mjerjenje u sportu*. Tuzla: Fakultet za tjelesni odgoj i sport Univerziteta u Tuzli. [In Bosnian]
- Munivrana, G. (2011). Strukturalna analiza tehničko-taktičkih elemenata stolnoteniske igre. *Doktorska disertacija*. Zagreb: Sveučilište u Zagrebu, Kineziološki fakultet. [In Croatian]
- Raab, M. (2004). Motor selection and execution training in table tennis. *International Journal of Psychology*, 39(5-6), 128-128.
- Sekulić, D., & Metikoš, D. (2007). *Osnove transformacijskih postupaka u kineziologiji*. Udžbenici Sveučilišta u Splitu. [In Croatian]

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ODNOS POSTURALNOG STATUSA STOPALA I EKSPLOZIVNE SNAGE NOGU ADOLESCENATA

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Sažetak: Cilj istraživanja bio je utvrđivanje razlika u ispoljavanju eksplozivne snage nogu i karličnog pojasa u odnosu na stepen spuštenosti svoda stopala i polni dimorfizam. Istraživanjem je obuhvaćeno 90 ispitanika (45 muškog i 45 ženskog pola), Srednje ekonomske škole u Novom Sadu, uzrasta 15 ± 0.5 godina. Status svoda stopala utvrđen je somatoskopskom metodom, a eksplozivna snaga motoričkim testovima skok udalj sa mesta i troskok sa mesta. Za utvrđivanje razlika korišćena je Univarijatna analiza varijanse, χ^2 - test i Student t - test za nezavisne uzorke, na nivou zaključivanja $p \leq 0.00$. Statistički značajne razlike utvrđene su između ispitanika sa dobrim i izrazito lošim statusom stopala ($p \leq 0.00$) i ispitanika sa lošim i izrazito lošim statusom stopala ($p \leq 0.000$). Takođe, utvrđene su statistički značajne razlike u odnosu na polnu pri-padnost u statusu svoda stopala i oba motorička testa ($\chi^2 = 9.867$; $p \leq 0.007$).

Ključne reči: ravna stopala, skok udalj sa mesta, troskok sa mesta, eksplozivna snaga nogu i karličnog pojasa, adolescenti.

Uvod

Stopalo kao višezglobni sistem, ima značajnu ulogu u statici i dinamici ljudskog organizma. Ona se ogleda u preuzimanju čitave težine tela i u različitim oblicima kretnih aktivnosti: hodanju, trčanju, skokovima, doskoci-ma i sl. (Ulić, 1997; Živković, 2000). Zajedničko delovanje mišića, tetiva, ligamenata i kostiju stopala, predstavlja kompleksan sistem, koji je u isto vreme i rigidan (nosi čitavu težinu tela) i fleksibilan te prilagodljiv različitim uslovima podloge (Twomey, 2006). Koštane, ligamentarne i mišićne strukture su odgovorne za formiranje i očuvanje svodova stopala, zahvaljujući kojima stopalo

RELATION BETWEEN THE POSTURAL FEET STATUS AND EXPLOSIVE STRENGTH OF LOWER EXTREMITIES IN ADOLESCENTS

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Abstract: The aim of this study was to determine the differences in the manifestation of explosive strength of legs and pelvis girdle regarding the degree of drooping medial arch of the feet and also according to gender differences. The research covered 90 respondents (45 males and 45 females), from the Secondary School Economics in Novi Sad, aged 15 ± 0.5 . The status of the foot arch was determined by using the clinical method, and the explosive strength by motoric tests of standing long jump and triple jump. For identifying the differences, One-Factor Analysis of Variance was used, χ^2 - test and Student t - test for independent samples, at the final degree of $p \leq 0.00$. Statistically significant differences were identified between the respondents with good and extremely poor foot status ($p \leq 0.00$) and the respondents with poor foot status ($p \leq 0.000$). Also, when it comes to gender, there were statistically significant differences in foot arch status and both motor tests ($\chi^2 = 9.867$; $p \leq 0.007$).

Key words: fallen arches, standing long jump, triple jump, explosive strength of legs and pelvic girdle, adolescents.

INTRODUCTION

Foot, as a multi-joint system has a significant role in the statics and dynamics of human body. It is reflected in taking the entire body weight and in different forms of motion activities: walking, running, jumping, jump landing, etc. (Ulić, 1997; Živković, 2000). The joint action of the muscles, tendons, ligaments and foot bones represents a complex system which is also rigid (it carries the entire body weight) and flexible and adaptable to different ground conditions. (Twomey, 2006). The bone, ligament and muscle structures are responsible for the formation and preservation of foot arches, thanks to which the foot

obavlja svoje osnovne funkcije: efikasno kretanje, distribuciju pritiska i pravilno trošenje snage.

Stopalo ostvaruje stabilnost i elastičnost zahvaljujući svodovima, transverzalnom i longitudinalnom (medijalnom i lateralnom), koji su određeni ne samo oblikom kostiju već i otpornošću ligamenata. Medijalni longitudinalni svod stopala je najviši i ima najznačajniju ulogu za optimalnu mehaniku stopala (Wilken, 2006), dok je lateralni longitudinalni svod niži i ima tendenciju slabljenja pod telesnom težinom (Kendall, McCreary, i Provance, 1993). Spuštenost medijalnog longitudinalnog svoda stopala označava se kao ravno ili spušteno stopalo. Početak formiranja svodova stopala poklapa se sa prvim opterećenjem, odnosno periodom kada dete počinje da se uspravlja, dok za period definitivnog formiranja još uvek ne postoji saglasnost istraživača.

Generalno, smatra se da se deca rađaju s ravnim stopalima (El et al., 2006), koja se zapažaju već u prvih godinama života, kada ona i počinju da hodaju. Stopalo najbrže raste do treće godine (Volpon, 1994), od koje ima gotovo konstantnu stopu razvoja podjednako za oba pola, sve do 12. godine. Svod stopala počinje ubrzano da se razvija između 2. i 6. godine i strukturalno sazreva oko 12 do 13. godine. Procenat ravnih stopala najveći je kod novorođenčadi pa do 2. godine života. Postojanje fleksibilnog ravnog stopala kod dece od 2. do 6. godine procentualno se javlja između 21% i 57%, a kod dece u osnovnoj školi procenat znatno pada na 13,4% do 27,6% (El, et al., 2006; Lin et al., 2001; Pfeiffer et al., 2006).

Snaga mišića obično se odnosi na silu ili obrtanje koju određena grupa mišića razvija tokom maksimalne voljne kontrakcije pod određenim uslovima (Jarić, 2002), a eksplozivna snaga je sposobnost ispoljavanja maksimalne snage u najkraćem mogućem roku (Petrović et al., 2013). Smatra se da promene posturalnog statusa stopala imaju uticaj na funkcionalne sposobnosti, koje se posmatraju kroz prizmu motoričke sposobnosti ispoljavanja eksplozivne snage nogu i karličnog pojasa. Cilj ovoga istraživanja bio je, stoga, utvrđivanje razlika u ispoljavanju eksplozivne snage donjih ekstremitet i karličnog pojasa adolescenata, u odnosu na status svoda stopala i pripadnost polu.

MATERIJAL I METOD

Radi utvrđivanja odnosa spuštenosti svoda stopala i eksplozivne snage donjih ekstremiteta i karličnog pojasa, opredelili smo se za istraživanje transverzalnog tipa.

performs all its basic functions: efficient movement, pressure distribution and proper strength use.

The foot achieves stability and flexibility thanks to the arches, transverse and longitudinal (medial and lateral), defined not only by the shape of bones but also by the resistance of ligaments. The medial longitudinal foot arch is the highest one and has the most important role for the optimal mechanics of the foot (Wilken, 2006), while the lateral longitudinal arch is lower and tends to weaken under the body weight (Kendall, McCreary, & Provance, 1993). Dropping of the medial longitudinal foot arch is marked as a fallen arch or a dropped arch. The beginning of the formation of the foot arches starts with the first load, i.e. the period when a child begins to sit up, while there is still no consensus of the researchers when it comes to defining the period of the definite formation.

It is generally believed that children are born with fallen arches (El et al., 2006), which are noticed in the first years of life, when they start to walk. The quickest growth of foot takes place up to the third year of life (Volpon, 1994), since when it has a constant development rate which is equal for both genders, until the age of 12. The foot arch begins to develop rapidly in children aged between 2 and 6, and its structure matures at the age of 12 and 13. The highest percentage of fallen arches is among infants up to 2 years of age. The percentage of flexible fallen arches in children aged between 2 and 6 is between 21% and 57%, while when it comes to primary school children, the percentage significantly drops to 13.4% up to 27.6% (El, et al., 2006; Lin et al., 2001; Pfeiffer et al., 2006).

Muscle strength usually refers to the force or reversion developed by a certain muscle group during the maximal voluntary contractions under certain conditions (Jarić, 2002), while explosive strength is the ability to manifest the maximal strength in the shortest period of time (Petrović et al., 2013). It is believed that changes in postural foot status influence the functional abilities, which are observed through the prism of motor ability to manifest explosive strength of legs and pelvic girdle. Therefore, the aim of this research was to determine the differences in the manifestation of explosive strength of lower extremities and pelvic girdle in adolescents, according to the foot arch status and gender.

MATERIAL AND METHOD

For the purpose of determining the comparison between the degree of pes planus and the explosive strength of the lower extremities and the pelvic girdle, we selected the research of transversal type.

Uzorak ispitanika

Uzorak ispitanika činilo je 90 učenika Srednje ekonomsko škole u Novom Sadu (45 muškog i 45 ženskog pola) uzrasta 15 ± 0.5 godina. Cilj istraživanja je bio je utvrđivanje razlika u eksplozivnoj snazi donjih ekstremita i karličnog pojasa u odnosu na status svoda stopala, kao i razlike u odnosu na polnu pripadnost. Ispitanici su na osnovu statusa stopala podeljeni u tri subuzorka: sa dobrim, lošim i izrazito lošim statusom stopala.

Metode merenja

Status svoda stopala utvrđen je kliničkom metodom, vizuelnom procenom u sagitalnoj ravni, gde su ispitanici sa dobrom statusom stopala ocenjeni nulom (0), sa lošim jedinicom (1) i izrazito lošim statusom stopala dvojkom (2). Za utvrđivanje eksplozivne snage donjih ekstremita i karličnog pojasa, korišćeni su motorički testovi skok udalj sa mesta i troskok sa mesta.

Metode obrade podataka

Za utvrđivanje razlika u ispoljavanju eksplozivne snage donjih ekstremita i karličnog pojasa u odnosu sa stepen spuštenosti svoda stopala, korišćena je jednosmerna Univarijatna analiza varijanse (ANOVA). Razlike između polova u odnosu na stepen spuštenosti svoda stopala utvrđene su χ^2 -testom na nivou značajnosti $p \leq 0.05$, a t - testom za nezavisne uzorke, utvrđene su statistički značajne razlike u odnosu na polni dimorfizam u oba motorička testa.

REZULTATI

Zastupljenost spuštenosti svoda stopala u odnosu na polni dimorfizam prikazana je u Tabeli 1. U uzorku ispitanika muškog pola, najveća je zastupljenost normalanog svoda stopala (55,6%), prvi stepen spuštenosti svoda stopala ima 26,7% ispitanika, dok je zastupljenost drugog stepena spuštenosti svoda stopala svega 17,8%.

Kod ispitanika ženskog pola najveći je postotak onih sa drugim (46,7%) i prvim stepenom spuštenosti (44,4%), a najmanja je zastupljenost ispitanica sa normalnim svodom stopala (8,9%).

Analizom razlika među polovima, utvrđeno je da ocenu jedan ima 62,5% a ocenu dva 72,4% ispitanika ženskog pola, dok je ocena nula češća kod ispitanika muškog pola (86,2%).

U Tabeli 2 prikazane su razlike u ispoljavanju eksplozivne snage donjih ekstremita i karličnog pojasa u odnosu na polni dimorfizam. Rezultat t – testa za nezavisne uzorke pokazuju da postoje statistički značajne razlike između polova u oba motorička testa ($p \leq 0.00$) u korist ispitanika muškog pola.

Sample of respondents

The sample included 90 pupils of the Secondary School of Economics in Novi Sad (45 males and 45 females) aged 15 ± 0.5 . The goal of this research was to determine the differences in explosive strength of lower extremities and pelvic girdle regarding the status of the foot arch, and the differences regarding the gender. Based on the status of their foot arch, the respondents are divided into three subsamples: with good, bad and extremely bad foot status.

Method of measurement

The feet arch status is defined by a clinical method, visual assessment in the sagittal plane, where the respondents with a good foot arch status were marked with a zero (0), respondents with a bad foot arch status were marked with one (1) and the respondents with extremely bad foot arch status were marked with (2). To determine the explosive status of lower extremities and pelvic girdle, we used standing long jump and triple jump motor tests.

Method of data processing

To determine the difference in the manifestation of explosive strength of lower extremities and pelvic girdle regarding the degree of fallen arches, we used the One-Factor Analysis of Variance (ANOVA). Differences among the genders regarding the degree of fallen arches were determined by χ^2 -test at the significance degree of $p \leq 0.05$, and t – test for independent samples, showing that there are significant statistical differences regarding the sexual dimorphism in both motor tests.

RESULTS

Incidence of drooping arch of the feet when it comes to the sexual dimorphism is shown in Table 1. In male respondents, the largest percentage had a normal foot arch (55.6%), the first degree of drooping feet arch had 26.7% of the respondents, while the percentage of those with the second degree of drooping feet arch was only 17.8%. When it comes to female respondents, the highest percentage is of those with the second (46.7%) and the first degree of drooping (44.4%), and the lowest percentage is of those with normal foot arches (8.9%).

The analysis among the sexes defined that the mark one had 62.5%, and the mark two had 72.4% of the female respondents, while the mark zero is more frequent in male respondents (86.2%).

Comparing the total sample, the differences between the genders, marks zero (60%) and one (63%) were recorded mostly among the male respondents, while the mark two is with 73% more frequent among the female respondents.

The Table 2 shows the differences in the manifestation of explosive strength of lower extremities and pelvic girdle regarding the sexual dimorphism. The result of the

Tabela 1. Zastupljenost spuštenosti svoda stopala u odnosu na polni dimorfizam / **Table 1.** Incidence of fallen longitudinal medial arch of the feet regarding the gender dimorphism

Ocene posturalnog statusa / Marks of postural status	Broj / Number %	Pol / Gender		Ukupno / Total
		M / M	Ž / F	
	N	25	4	
0	% unutar pola / within gender	86.2%		100.0%
	% statusa svoda stopala / foot arch status	55.6%		32.2%
	% ukupno / total	27.8%		32.2%
1	N	12	20	32
	% unutar pola / within gender	37.5%		100.0%
	% statusa svoda stopala / foot arch status	26.7%		35.6%
2	% ukupno / total	13.3%		35.6%
	N	8	21	29
	% unutar pola / within gender	27.6%		100.0%
Ukupno	% statusa svoda stopala / foot arch status	17.8%		32.2%
	% ukupno / total	8.9%		32.2%
	N	45	45	90
Ukupno	% unutar pola / within gender	50.0%		100.0%
	% statusa svoda stopala / foot arch status	100.0%		100.0%
	% ukupno / total	50.0%		100.0%

 $\chi^2=23.034$ $p=0.00$ **Tabela 2.** Razlike u ispoljavanju eksplozivne snage donjih ekstremiteta i karličnog pojasa u odnosu na polnu pripadnost / **Table 2.** Differences in the manifestation of explosive strength of lower extremities and pelvic girdle regarding the gender

Varijable / Variables	M / M		Ž / F		t	p
	AS	S	AS	S		
Skok udalj sa mesta / Standing long jump	209.93	18.794	163.69	21.937	10.739	0.00
Troskok sa mesta / Triple jump	604.71	63.053	472.82	55.934	10.497	0.00

U Tabeli 3 prikazani su rezultati ispoljavanja eksplozivne snage donjih ekstremiteta i karličnog pojasa u odnosu na status svoda stopala, ukupnog uzorka ispitanih u oba motorička testa.

t – test for independent samples shows that there are statistically significant differences among both genders in both motor tests ($p \leq 0.00$) in favour of male respondents.

The Table 3 shows the results of explosive strength of lower extremities and pelvic girdle in comparison with the foot arch status of the total sample of respondents in

Tabela 3. Razlike u parametrima eksplozivne snage donjih ekstremiteta u odnosu na status svoda stopala ukupnog uzorka ispitanih / **Table 3.** Differences in the parameters of the explosive strength of lower extremities regarding the foot arch status of the total sample of respondents

Varijable / Variables	Marks	AS	S	F		p
				Total	F	
Skok udalj sa mesta / Standing long jump	0	207.14	23.349	12.138	0.00	
	1	180.66	31.106			
	2	173.28	27.428			
	Total	186.81	30.873			
Troskok sa mesta / Triple jump	0	591.00	68.177	9.373	0.00	
	1	524.88	91.993			
	2	501.86	81.653			
	Total	538.77	88.937			

Kako bi se ustanovile razlike između parova grupa na osnovu podele prema statusu stopala, urađena je LSD post-hoc analiza (Tabela 4). Na osnovu dobijenih rezultata, može se zaključiti da postoje statistički značajne razlike u motoričkoj efikasnosti između ispitanika koji imaju normalan svod stopala i ispitanika koji imaju manje ili više spušten svod stopala. Ove razlike se javljaju u oba motorička testa, međutim ne postoje statistički značajne razlike u motoričkoj efikasnosti između ispitanika sa ocenom 1 i 2.

Tabela 4. Razlike između parova grupa (razvrstanih prema statusu stopala) u eksplozivnoj snazi donjih ekstremiteta / **Table 4.** The differences between pairs of groups (sorted by the feet status) in explosive strength of lower extremities

Variable / Variables	(I)	(J)	AS (I-J)	Sig.
Skok udalj sa mesta / Standing long jump	0	1	26.482	0.00
		2	33.862	0.00
	1	0	-26.482	0.00
		2	7.380	0.30
	2	0	-33.862	0.00
		1	-7.380	0.30
Troskok sa mesta / Triple jump	0	1	66.125	0.00
		2	89.138	0.00
	1	0	-66.125	0.00
		2	23.013	0.27
	2	0	-89.138	0.00
		1	-23.013	0.27

DISKUSIJA I ZAKLJUČAK

Prevalenca ravnog stopala kod dece u odnosu na uzrast, pol, uhranjenost i fizičku aktivnost, problematika je mnogih istraživanja. Zastupljenost ravnih stopala kod dece uzrasta od 7 do 11 godina beleži se kod ispitanika muškog pola u većem procentu nego kod ispitanica (Puzović i sar., 2010). Ovakvu pojavu istraživači tumače time što se kod dečaka sporije povlači masno tkivo ("ja-stuće") na tabanu za razliku od devojčica.

U našem istraživanju rezultati pokazuju da ispitanici muškog pola imaju u većem procentu normalan svod stopala, a ispitanice ženskog pola spušten svod stopala I i II stepena. Ovako dobijeni rezultati ukazuju na činjenicu da su ispitanici muškog pola ovog uzrasta fizički aktivniji i češće nego ispitanice uključeni u sportske aktivnosti. Rezultate posturalnog statusa potrebno je tumačiti zajedno sa opštim rastom i razvojem mlađih. Tako, neki autori raniji ulazak devojčica u pubertet objašnjavaju kroz zastupljenost ravnih stopala u mlađem uzrastu, za razliku od dečaka. Kod dečaka pubertet počinje nešto kasnije, pa se u skladu sa tim najveći broj poremećaja javlja u starijem uzrastu (Jovović, Čanjak, 2010).

both motor tests.

In order to define the differences between the group pairs based on the division according to the foot status, the LSD post-hoc analysis was done (Table 4). Based on the received results, it can be concluded that there are statistically significant differences in motor efficiency between the respondents with a normal foot arch and the respondents with less or more drooping foot arch. These differences occur in both motor tests, however there are no statistically significant differences in motor efficiency between the respondents marked with 1 and 2.

DICUSSION AND CONCLUSION

Prevalence of the fallen arches in children when it comes to the age, gender, nutritional status and physical activity, is a problem of many studies. The incidence of fallen arches in children aged between 7 and 11, is recorded in male respondents more than in female respondents (Puzović et al., 2010). Such incidence as interpreted by the researchers, is explained by the fact that the adipose tissue of the sole ("pad") is withdrawn more slowly in boys than in girls.

The results of our research show that the male respondents have a larger percentage of normal feet arches, while the female respondents have a larger percentage of the first and second degree of drooping foot arch. Such results point out the fact that the male respondents of this age are more physically active and more frequently involved in sport activities than female respondents. The results of the postural status should be interpreted hand in hand with the general growth and development of the young.

It is wrong to interpret the results of the postural status separately and in isolation from the overall growth and development. Some authors explain the earlier start of pu-

Zbog ovako različitih mišljenja bilo je neophodno uvrstiti i neki pokazatelj snage nogu kroz motoričke testove. Motoričke testove bolje su uradili ispitanici muškog pola. što je očekivano, a u odnosu na status svoda stopala, efikasniji su bili ispitanici sa fiziološkim svedom. Oba motorička testa izvode se sunožnim odrazom sa mesta gde su pri odskoku angažovani fleksori stopala. Kod osoba sa ravnim stopalima, ovi mišići pokazuju znake insuficijencije, što se odražava na efikasnost skoka.

Rezultati našeg istraživanja razlikuju se od rezultata istraživanja Lizisa. Posadzkog i Smita (Lizis, Posadzki & Smith, 2010), koji ukazuju na nepostojanje statistički značajne razlike u ispoljavanju eksplozivne snage nogu u odnosu na posturalni status longitudinalnog svoda stopala kod ispitanika oba pola. Takođe, rezultati se ne podudaraju ni sa istraživanjem Aleksandrovića i Kotarasa (2015), u kojem nije utvrđena statistički značajna razlika u ispoljavanju eksplozivne snage donjih ekstremiteta u odnosu na posturalni status stopala. Spušten uzdužni svod stopala, prema ovim autorima, ne predstavlja prepreku za ispoljavanje eksplozivne snage donjih ekstremiteta. Razlog za nepodudaranje rezultata našeg sa navedenim istraživanjima, verovatno leži u činjenici različitog broja ispitanika u istraživanjima.

Nakon detaljne analize rezultata i poređenja sa pretходним istraživanjima, može se izneti zaključak da je posturalni status kompleksan, te da se ne može posmatrati izolovano od antropometrijskog i motoričkog statusa. U dalja istraživanja, neophodno je uključiti što više pokazatelja rasta i razvoja, naročito kod dece kod koje on nije završen.

Mnoga istraživanja ukazuju na povećanu incidencu ravnog stopala kod dece mlađe od 18 godina (Đorđević, Jorgić i Stanojević, 2015), naročito kod dece osnovnoškolskog uzrasta. Shodno tome, neophodna je rana intervencija: rano otkrivanje posturalnog poremećaja, uključivanje dece u korektivni program sa pravilnim odabirom vežbi, smanjenje telesne težine dece, izbor adekvatne obuće te pravovremeno uključivanje dece u razne fizičke aktivnosti. Ovo su samo neki od činilaca koji mogu dovesti do prevencije nastanka i razvoja ravnog stopala kod dece.

Izjava autora

Autori pridonijeli jednakо.

Konflikt interesa

Mi izjavljujemo da nemamo konflikt interesa

Author's statement

The authors contributed equally.

Conflict of interest

We declare that we have no conflict of interest

berty in girls by the presence of fallen arches at a young age, as opposed to boys. Puberty in boys starts a little later than in girls, and therefore the largest number of disorders occurs in older age (Jovović, Čanjak, 2010).

Due to the differences in opinions it was necessary to include some indicators of leg strength through the motor tests. It was expected that male subjects

The motor tests were done better by male respondents, which was expected, and when it comes to the foot arch status, the respondents with physiological arches were more efficient. Both motor tests were done with a two-foot jump where foot flexors are engaged in the jump. As for those with fallen arches, these muscles show signs of insufficiency, which has an impact on the efficiency of the jump.

The results of our study differ from the results of those by Lizis, Posadzki & Smith (2010), which indicate the absence of statistically significant differences in the manifestation of explosive strength of legs comparing to the postural status of longitudinal foot arch in both male and female respondents. The results do not match the research by Aleksandrovic & Kottaras (2015) either, in which there was no statistically significant difference in the manifestation of explosive strength of lower extremities in relation to the postural foot status. Fallen longitudinal medial foot arch, according to these authors, does not represent an obstacle for the manifestation of the explosive strength of lower extremities. The reason of the mismatch of the results of our mentioned research is probably due to the fact that the research has been conducted on a different number of respondents.

After a detailed analysis of the results and comparisons with previous research, we can express the conclusion that the postural status is complex, and cannot be viewed in isolation from the anthropometric and motor status. Further research need to involve as many indicators of growth and development as possible, especially in children, in which it had not been completed.

Many studies point to an increased incidence of fallen arches in children under 18 (Đordjević, Jorgić & Stanojević, 2015), especially in children of primary school age. Accordingly, early intervention is necessary: early detection of postural disorders, involvement of children in corrective programmes with the proper selection of exercises, weight reduction in children, the selection of appropriate footwear, and timely involvement of children in various physical activities. These are just some of the factors that can lead to the prevention of the occurrence and development of fallen arches in children.

LITERATURA / REFERENCES

- Aleksandrovic, M., & Kottaras, S. (2015). Does the Precondition for Drooping Arch of the Feet Diminish Explosive Leg Strength: a Pilot Study. *Facta Universitatis Series: Physical Education and Sport*, 13(2), 303-309.
- Dorđević, S., Jorgić, B., & Stanojević, I. (2015). Effects of exercise programs on pes planus in children under 18 years of age: a systematic review. *Acta Kinesiologica*, 9(2), 7-11.
- El, O., Akcali, O., Kosay, C., Kaner, B., Arslan, Y., Sagol, E., Soylev, S., Iyidogan, D., Cinar, N., & Peker, O. (2006). Flexible flatfoot and related factors in primary school children: a report of a screening study. *Rheumatology International*, 26, 1050-1053.
- Jaric, S. (2002). Muscle strength testing: the use of normalization for body size. *Sports Medicine*, 32, 615–631.
- Jovović, V., & Čanjak R. (2010). Frekvencija ravnog stopala kod školske djece različitog uzrasta. U Zbornik radova: *Anthropological aspect of Sport. Physical Education and Recreation*, 49-55. [In Serbian]
- Kendall, F. P., McCreary, E. K., & Provance, P. G. (1993). *Muscles: Testing and Function*. Baltimore, MD: Williams & Wilkins.
- Lin, C. J., Lai, K. A., Kuan, T. S., & Chou, Y. L. (2001). Correlating factors and clinical significance of flexible flat foot in preschool children. *Journal of Pediatric Orthopedics*, 21(3), 378-382.
- Lizis, P., Posadzki, P., & Smith, T. (2010). Relationship Between Explosive Muscle Strength and Medial Longitudinal Arch of the Foot. *Foot & Ankle International*, 31(9), 815-822.
- Pfeiffer, M., Kotz, R., Ledl, T., Hauser, G., & Sluga, M. (2006). Prevalence of flat foot in preschool-aged children. *Pediatrics*, 118(2), 634-639.
- Petrović, M., Obradović, B., Golik-Perić, D., & Bubanj, S. (2013). Jumping abilities are not related to foot shape. *Facta Universitatis, Series: Physical Education and Sport*. 11(10), 299-305.
- Puzović, V., Đorđević, D., Karaleić, S., Obrenović, M., Medić, V., Jakovljević, V. (2010). Prevalenca ravnog stopala kod dece od 7-11 godina. *PONS Medical Journal*, 7(3): 98-102. [In Serbian]
- Živković, D. (2000). *Teorija i metodika korektivne gimnastike*. Niš: SAI. [In Serbian]
- Twomey, D. *Performance differences between normal and low arched feet in 9-12 years old children*. Doctoral thesis. University of New South Wales. 2006; Retrieved from <http://www.library.unsw.edu.au/thesis/adt-NUN/uploads/approved/adt-NUN20060615.141954/public/01front.pdf>
- Ulić, D. (1999). *Osnove kineziterapije*. Novi Sad: Samostalno autorsko izdanje. [In Serbian]
- Volpon, J. (1994). Footprint analysis during growth period. *Journal of Pediatric Orthopedics*, 14(1), 83-85.
- Wilken, J. M. (2006). *The effect of arch height on tri-planar foot kinematics during gait*. Doctoral thesis: University of Iowa, Iowa Research Online. <http://ir.uiowa.edu/etd/63>

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EFEKTI KINEZILOŠKIH AKTIVNOSTI NA TRANSFORMACIJU MORFOLOŠKIH KARAKTERISTIKA I MOTORIČKIH SPOSOBNOSTI ŽENA RAZLIČITE ŽIVOTNE DOBI

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Sažetak: Ovo istraživanje je provedeno sa ciljem utvrđivanja efekata različitih kinezioloških aktivnosti na transformaciju morfoloških karakteristika i motoričkih sposobnosti žena različite životne dobi. Uzorak ispitanika, sačinjavalo je 160 ispitanica – radnica u industriji obuće “Obuća” Zvornik, uzrasta od 20-44 godine starosti. Isti uzorak je bio podijeljen na osnovu hronološke starosti na 4 subuzorka - grupe, i to: 20-25 godina, 26-31 godinu, 32-37 godina i 38-44 godine. U ovom istraživanju primjenjeno je deset (10) varijabli morfoloških karakteristika i deset (10) varijabli za procjenu motoričkih sposobnosti. Za utvrđivanje razlika između eksperimentalnih grupa na finalnom mjerenu sa parcijalizacijom razlika između grupa na inicijalnom mjerenu i utvrđivanja efekata kineziološkog tretmana na transformaciju morfoloških karakteristika i motoričkih sposobnosti primjenjena je multivarijantna analiza kovarijanse (MANCOVA), a na univarijantnom nivou primjenja je univarijantna analiza kovarijanse (ANCOVA). Dakle u globalnoj procjeni kvaliteta i opravdanosti primjene programiranog kineziološkog tretmana u trajanju 6 mjeseci, možemo konstatovati da je isti proizveo značajne efekte na transformaciju morfoloških karakteristika i motoričkih sposobnosti kod istraživanog uzorka. Statistički najznačajniji efekti kinezioloških aktivnosti (eksperimentalnog tretmana), ostvareni su kod prve i druge grupe ispitanica koje su hronološkog uzrasta 20 do 25 godina i 26 do 31 godine.

Ključne riječi: radnice, transformacioni efekti, morfološka, motorika, kineziološke aktivnosti.

Uvod

Njemački filozof Šopenhauer (*Svijet kao volja i predstava*, 1844) ocijenio je da su zdravlje, mladost i sloboda tri najveća dobra života koja ne umijemo da ci-

EFFECTS OF KINESIOLOGICAL ACTIVITIES ON TRANSFORMATION OF MORPHOLOGICAL CHARACTERISTICS AND MOTOR ABILITIES OF WOMEN OF DIFFERENT AGES

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Abstract: This research was conducted with the aim of determining the effects of various kinesiology activities on the morphological transformation of features and motor abilities of women of different ages. The sample was consisted of 160 respondents - workers in the shoe industry "Obuća" Zvornik, ages 20-44. The same pattern was divided on the basis of chronological age on 4 sub-samples/ groups, as follows: 20-25 years, 26-31 years, 32-37 years and 38-44 years old. In this research were applied ten (10) variables of morphological characteristics and ten (10) variables to estimate the motor abilities. To determine the difference between experimental groups on the final measuring by fragmentation difference between the groups at the initial measuring and determining the effects of kinesiological treatment on the transformation of morphological characteristics and motor abilities was applied multivariate analysis of covariance (MANCOVA), and the invariant level was applied the invariant analysis of covariance (ANCOVA). So in a global assessment of the quality and justification of applying the programmed kinesiology treatment in six months, we can say that it produced significant effects on the transformation of morphological characteristics and motor abilities in the study sample. Statistically the most significant effects of kinetic activities (experimental treatment), were achieved at the first and second groups of women who are in chronological age from 20-25 and 26-31 years old.

Keywords: workers, transformation effects, morphology, motor skills, kinesiology activities.

INTRODUCTION

German philosopher Schopenhauer (*The World as will and performances*, 1844) estimated that the health, youth and freedom of the three greatest goods of life

jenimo dok ih imamo, nego tek kada ih izgubimo. To su vrijednosti za koje većina ljudi smatra da su date same po sebi, što je svojstveno samo mladosti, dok stepen zdravlja i slobode u velikoj mjeri zavisi od napora koji ulažemo da bismo ih dostigli.

Zdravlje je stanje potpunog, fizičkog, psihičkog i socijalnog blagostanja, a ne samo odsustvo bolesti (prema WHO). Savremena nauka kvantitativno definiše zdravlje kao sumu "rezervnih kapaciteta" funkcionalnih sistema. U tom smislu treba da razmislimo dali svojim načinom života samo trošimo i smanjujemo rezerve zdravlja i da li dovoljno činimo da očuvamo i unaprijedimo svoje zdravlje. Uglavnom se ponašamo kao 'potrošači' a premalo i rijetko kao 'proizvođači svoga zdravlja (Mitić, 2001).

Fizička aktivnost predstavlja posebno stanje zdravog organizma koje se karakteriše povećanom potrošnjom energije. Prema definiciji Američkog Koledža Sportske Medicine (ACSM, 2001), fizička aktivnost je svaki pokret tijela koji nastaje kao posljedica mišićne kontrakcije i koji dovodi do potrošnje energije. Dakle, ona obuhvata širok dijapazon različitih aktivnosti, igru, fizičko (tjelesno) vježbanje, takmičarske sportske discipline, ali i fizički napor tokom profesionalnih aktivnosti ili tokom obavljanja nekih kućnih poslova, jednom riječju bilo koju vrstu fizičkog angažmana. Fizička aktivnost je ključni elemenat za duži, zdraviji i srećniji život.

Primjena fizičkih aktivnosti u službi zdravlja zahtjeva uvažavanje određenih principa, sličnih onima koji se koriste kod primjene farmaceutskih preparata. Prije svega, treba imati u vidu da fizička aktivnost nije univerzalno preventivno ili terapijsko sredstvo. Kod određenih oboljenja ona je indikovana, a kod nekih kontraindikovana. Nedovoljna „doza“ fizičke aktivnosti neće izazvati adaptogene promjene, koje su neophodne da bi se ostvarili zdravstveni efekti. S druge strane, „predozirana“ fizička aktivnost može dovesti do različitih oblika oštećenja zdravlja. Optimalni zdravstveni efekti uz smanjenje zdravstvenog rizika na minimum, mogu se očekivati samo onda kada su isključene kontraindikacije i kada je fizička aktivnost pravilno dozirana. American Alliance for Health, Physical Education, Recreation and Dance (AAHPERD, 1989).

Programiranje (individualno doziranje) fizičkih aktivnosti je postupak njihovog prilagođavanja biološkim karakteristikama - polu i godinama starosti, kao i funkcionalnom statusu - nivou aerobne sposobnosti i zdravstvenom stanju učesnika u programu. Ovo se ostvaruje modelovanjem tri osnovna elementa svakog programa fizičke aktivnosti - učestalosti, intenziteta i trajanja, uz uvažavanje opštih preporuka o obliku kretnih aktivnosti (Mikić, i sar., 2012).

that do not know how to appreciate until we have them, but only when we lose them. These are values to which most people consider they are given by itself, which is peculiar to youth, while the level of health and freedom largely depends on the effort that we invest in order to achieve them.

Health is a state of complete, physical, mental and social well-being and not merely the absence of disease (according to WHO). Modern science quantitatively defines health as the sum of "spare capacities" of functional systems. In this sense, we should consider whether by our lifestyle we only spend and deplete health reserves and are we doing enough to preserve and promote our health. Basically we behave here as "consumers" and too little and rarely as "producers" of our health (Mitic , 2001).

Physical activity presents a particularly healthy state of the body that characterizes by increased consumption of energy. As defined by the American College of Sports Medicine (ACSM, 2001), physical activity is every body part movement resulting as a consequence of muscle contraction which leads to energy consumption. So it covers a wide range of different activities, games, physical (body) exercise, competitive sports disciplines, but also the physical effort during professional activities or during the performance of some household chores, or in one word any type of physical engagement. Physical activity is a key element for a longer, healthier and happier life.

Doing physical activity for health requires respecting certain principles, similar to those used when using pharmaceutical products. Before all, it should be noted that physical activity is not universally preventive or therapeutic remedy. For certain sickness it is indicated, and in some contraindicated. Insufficient "dose" of physical activity will not cause adapting changes, which are necessary to achieve health effects. On the other hand, "overdosed" physical activity can lead to various forms of damage to health. Optimal health effects by reducing health risks to a minimum can be expected only when excluded contraindications and when physical activity is properly dosed (American Alliance for Health, Physical Education, Recreation and Dance -AAHPERD, 1989).

Programming (individual dosage) of physical activity is the process of adapting to their biological characteristics - gender and age, as well as to a functional status - the level of aerobic ability and health of participants in the program. This is achieved by modeling the three basic elements of any program of physical activity - frequency, intensity and duration, taking into account the general recommendations about the form of motion activities (Mikic, et al., 2012).

Osnovni cilj ovog istraživanja predstavlja utvrđivanje efekata različitih kinezioloških aktivnosti na transformaciju morfoloških karakteristika i motoričkih sposobnosti žena različite životne dobi.

METODE ISTRAŽIVANJA

Uzorak ispitanika

Uzorak ispitanika, sačinjavalo je 160 ispitanica – radnica u industriji obuće “Obuća” Zvornik, uzrasta od 20 – 44 godine starosti. Isti uzorak je bio podijeljen na osnovu hronološke starosti na subuzorke - grupa, i to: 20-25 godina 40 ispitanika; 26-31 godina 40 ispitanika; 32-37 godina 40 ispitanika; 38-44 godine 40 ispitanika.

Uzorak varijabli

Uzorak varijabli za procjenu morfoloških karakteristika

- **HEIGHT** - Tjelesna visina.
- **WEIGHT** - Tjelesna težina.
- **AOBGRU** - Obim grudnog koša
- **AOBNAD** - Obim nadlaktice
- **AOBTRB** - Obim trbuha
- **AOBNAT** - Obim natkoljenice
- **ANABTR** - Kožni nabor trbuha
- **ANABNA** - Kožni nabor nadlaktice
- **ANABLE** - Kožni nabor leđa
- **BMI** - Body mass index.

Uzorak varijabli za procjenu motoričkih sposobnosti ispitanica

Varijable za procjenu gipkosti

- **MFLISK** - Iskret s palicom
- **MFLPRK** - Pretklon na klupici
- **MFLPDR** - Pretklon raskoračno
- **MFLZLP** - Zanoženje iz ležanja na prsima
- **MFLPLK** - Prenoženje iz ležanja na leđima

Varijable za procjenu repetetivne snage

- **MRCDTL** - Dizanje trupa iz ležanja na leđima za 30°
- **MRCZTL** - Dizanje trupa iz ležanja na trbuhi (zakloni)
- **MRCSKL** - Sklekovci sa koljenama

Varijable za procjenu brzine frekvencnih pokreta

- **MBFTAP** - Taping rukom
- **MBFTAN** - Taping nogom

Eksperimentalni program je proveden sa četiri grupe ispitanica različitog hronološkog uzrasta. Sve četiri grupe su realizovale šestomjesečni program sa 72 časa rekreativnog vježbanja-High Low aerobik. Frekvencija vježbanja je bila 3x sedmično, a svaki trening je trajao 60 minuta. Pored vježbanja aerobika sa ispitanicama je proveden i program vježbi oblikovanja u okviru rekreativne pauze tri puta nedjeljno po 15 minuta.

The main objective of this research is determining the effects of various kinesiology activities in transformation of morphological characteristics as well as the motor skills of women of different ages.

RESEARCH METHODS

The sample. The sample was composed of 160 respondents - workers in the shoe industry “Obuća” Zvornik, ages from 20-44. The same pattern was divided on the basis of chronological age on subsamples/ groups, namely: 20-25 years 40 respondents; 26-31 years 40 respondents; 32-37 years 40 respondents; 38-44 years 40 respondents.

The sample of variables

The sample of variables to assess the morphological characteristics

- **HEIGHT** - Body height.
- **WEIGHT** - Body weight.
- **AOBGRU** - The scope of thorax
- **AOBNAD** - The scope of the upper arm
- **AOBTRB** - The scope of the stomach
- **AOBNAT** - The scope of the upper leg
- **ANABTR** - Abdominal skin fold
- **ANABNA** - Upper arm skin fold
- **ANABLE** - Skin fold of the back
- **BMI** - Body mass index.

The sample of variables to assess motor skills of respondents

Variables to estimate the flexibility

- **MFLISK** - twist with the handle
- **MFLPRK** - reach over the bench
- **MFLPDR** - bent astride
- **MFLZLP** - bent from lying on his chest
- **MFLPLK** - bent over from lying on her back

The variables for assessing the repetitive strength

- **MRCDTL** - lifting the trunk from lying on your back for 30 °
- **MRCZTL** - lifting the trunk from lying on the stomach (huts)
- **MRCSKL** - Push-ups from knees and up

The variables to estimate the speed of frequent movements

- **MBFTAP** - hand taping
- **MBFTAN** - foot taping

The experimental program was conducted with four groups of subjects with different chronological age. All four groups have implemented a six-month program with 72 hours of recreational exercise-High Low aerobics. The frequency of exercise was 3 times a week, and each training lasted 60 minutes. In addition to aerobic exercise with respondents was conducted also an exercise forming program within recreational breaks three times a week for 15 minutes.

Statistička obrada podataka

Za utvrđivanje statističke značajnosti razlika rezultata među ispitivanim grupama na finalnom mjerenu sa parcijalizacijom eventualnih razlika između grupa na inicijalnom mjerenu i utvrđivanje efekata eksperimentalnog programa za transformaciju morfoloških karakteristika i motoričkih sposobnosti primjenjena je Multivarijantna analiza kovarijanse (MANCOVA), a na univarijantnom nivou primjenjena je univarijantna analiza kovarijanse (ANCOVA).

REZULTATI I DISKUSIJA

Efekti eksperimentalnog programa primjenjenih kinezioloških aktivnosti na transformaciju morfoloških karakteristika i motoričkih sposobnosti ispitanica

U cilju utvrđivanja efekata kinezioloških aktivnosti na transformaciju morfoloških karakteristika i motoričkih sposobnosti ispitanica i informacija u kojim varijablama su ispitanice najviše napredovale primjenjena je multivarijantna i univarijantna analiza kovarijanse (MANCOVA - ANCOVA).

Efekti eksperimentalnog programa primjenjenih kinezioloških aktivnosti na transformaciju morfoloških karakteristika ispitanica.

Uvidom u (tabelu 1) gdje je prikazana multivarijantna analiza kovarijanse primjenjenih varijabli morfoloških karakteristika između ispitivanih grupa na finalnom mjerenu, sa parcijalizacijom i neutralizacijom evidentiranih razlika na inicijalnom mjerenu, može se konstatovati da je prisutna statistička značajnost međugrupnih razlika na nivou od .00 ($p=.000$). Dakle, primjenjeni eksperimentalni program je uticao pozitivno na transformaciju primjenjenih morfoloških karakteristika ispitanica tretiranih grupa.

Statistical data analysis

To determine the statistical significance of differences among the results of tested groups at the final measuring with fragmentation of possible differences between the groups at the initial measurement and determination of the effects of experimental program for the transformation of morphological characteristics and motor abilities was applied the **Multivariate analysis of covariance (MANCOVA)** and at the invariant level was applied invariant analysis of covariance (**CANOVA**).

RESULTS AND DISCUSSION

The effects of the experimental program of applied kinesiology activities in the transformation of morphological characteristics and motor abilities of respondents

In order to determine the effects of kinetic activity on the transformation of morphological characteristics and motor abilities of the respondents and the information in which variables have the subjects most advanced was applied multivariate and invariant analysis of covariance (MANCOVA - ANCOVA).

Effects experimental program of applied kinesiology activities in the transformation of morphological characteristics of the respondents

Analyzing (Table 1) shows multivariate analysis of covariance applied variables of morphological characteristics between the studied groups at a final measurement, the fragmentation and neutralization of recorded difference at the initial measurement, it can be noted that there is statistical significance of intergroup differences at the level of .00 ($p = .000$). Therefore, applied experimental program influenced positively the transformation of applied morphological characteristics of subjects in treated group.

Tabela 1. Testiranje značajnosti efekata programa kinezioloških aktivnosti na multivarijantno nivou – MANCOVA / **Table 1.** Testing the significance of the effects of program of kinetic activity on multivariate level - MANCOVA

MAIN EFFECT: GRUPA (ispitanice.sta)		
Manova test	Value	p-level
Wilks Lambda	.6896	
Rao R Form 2 (24,286)	2.8973	.0000
Pillai-Bartlett Trace	.30672	
V (24,294)	2.8683	.0000

Tabela 2. Testiranje značajnosti efekata programa kinezioloških aktivnosti na univarijantnom nivou – ANCOVA model /
Table 2. Testing the significance of the effects of program activities of kinesiology at invariant level - ANCOVA model

Varijable / variables	Adjustend means (ispitanice.sta)					
	I grupa / Group 20-25 god.	II grupa / Group 26-31 god. / years.	III grupa / Group 32-37 god. / years.	IV grupa / Group 38-44 god. / years.	F (df 1,2)	p-level sign.
HEIGHT	165.6007	164.5391	161.6506	163.4032	2.3062	.0961
WEIGHT	57.9500	60.8432	65.2663	65.3766	12.1430	.0000
AOBGRU	86.1883	86.9934	89.9784	91.8843	3.8630	.0420
AOBNAD	26.4734	28.1432	29.3563	28.9941	1.8676	.0862
AOBTRB	76.7356	77.9451	82.5263	84.1035	13.4720	.0000
AOBNAT	52.5066	53.5661	57.3342	57.3661	4.3631	.0448
ANABTR	6.9367	7.3572	10.3681	10.4452	5.0430	.0206
ANABNA	9.3671	9.2103	12.1835	12.5311	1.3672	.2014
ANABLE	7.7446	8.0402	10.1966	10.6630	3.9461	.0412
BMI	22.3533	23.7433	25.8763	26.2060	4.1632	.0314

Značajan doprinos razlici između grupa na finalnom mjerenu (tabela 2.), uz neutralizaciju razlike na inicijalnom mjerenu, ima većina primjenjenih varijabli, sem varijabli: tjelesna visina – HEIGHT, na nivou značajnosti (.096), obim nadlakta – AOBNAD, na nivou značajnosti (.086) i kožni nabor nadlakta – ANABNA, na nivou značajnosti (.201), te se može pretpostaviti da je to posljedica primjene eksperimentalnog programa kinezioloških aktivnosti.

Uglavnom se može konstatovati da su kod sve četiri eksperimentalne grupe utvrđene statistički značajne razlike u većini primjenjenih morfoloških varijabli, a tu se prije svega misli na varijable tjelesne mase, potkožnog masnog tkiva, body mass index-a i nekih varijabli obima tijela. Statistički najznačajniji efekti kinezioloških aktivnosti (eksperimentalnog tretmana), ostvareni su kod prve i druge grupe ispitanica koje su hronološkog uzrasta 20 do 25 godina i 26 do 31 godine. Dobijeni rezultati istraživanja su u okviru rezultata koje su u svojim istraživanjima dobili (Can i sar., 2004; Bayios i sar., 2006; Arslan i sar., 2010; Koroljev i sar., 2011; Strbad i sar., 2011; Zrnić i sar., 2012; Mikić i sar., 2008, i 2013), kojima su potvrđene pozitivne promjene morfoloških karakteristika i sastava tijela žena nakon provedenog rekreativnog vježbanja.

Efekti eksperimentalnog programa primjenjenih kinezioloških aktivnosti na transformaciju motoričkih sposobnosti ispitanica

Uvidom u (tabela 3) gdje je prikazana multivarijantna analiza kovarijanse primjenjenih varijabli motoričkih sposobnosti između ispitivanih grupa na finalnom mjerenu, sa parcijalizacijom i neutralizacijom evidentiranih

A significant contribution to the difference between the groups at the final measurements (Table 2), with the neutralization of the difference in the initial measurement, has the most applied variables except variables: body height - HEIGHT, the significance level (096), the scope of the upper arm - AOBNAD, the level of significance (.086) and a skin fold of the arm - ANABNA, the level of significance (.201), and can be assumed that this is a consequence of applying the experimental program of kinetic activities.

Basically it can be concluded that in all four experimental groups were no statistically significant differences in most of applied morphological variables, but here primarily it refers to the variables of body mass, body fat, body mass index and some variable of body scopes. Statistically the most significant effects of kinetic activities (experimental treatment), were achieved in the first and second group of women who are in chronological age from 20-25 and 26-31. The results of research are in the context of the results that were also in the studies (Ca not al. 2004; Bayios et al., 2006; Arslan et al., 2010; Korolev et al., 2011; Strbad et al., 2011; Zrnić et al., 2012; Mikic et al., 2008, and 2013), which have confirmed positive changes in morphological characteristics and the composition of women's bodies after the recreational exercise.

The effects of experimental program of applied kinesiology activities in the transformation of motor skills of respondents

Analyzing (Table 3) where it shows a multivariate analysis of covariance of applied variables of motor abilities between the groups at the final measurement, the fragmentation and neutralization of recorded differences

razlika na inicijalnom mjerenu, može se konstatovati da je prisutna statistička značajnost međugrupnih razlika na nivou od ($p = .000$). Dakle, primjenjeni eksperimentalni program je uticao pozitivno na transformaciju većine motoričkih sposobnosti ispitanica tretiranih grupa.

Tabela 3. Testiranje značajnosti efekata programa kinezioloških aktivnosti na multivarijantnom nivou – MANCOVA model /
Table 3. Testing of the significance of the program effects of kinesiology activities at the multivariate level - MANCOVA model

MAIN EFFECT: GRUPA / GROUP (ispitanice.sta)		
Manova test	Value	p-level
Wilks-Lambda	.5347	
Rao R Form 2 (18,229)	8.3315	.0000
Pillai-Bartlett Trace	.4836	
V (18,223)	6.1350	.0000

Tabela 4. Testiranje značajnosti efekata programa kinezioloških aktivnosti na univarijantnom nivou - ANCOVA model /
Table 4. Testing the significance of the program effects of kinetic activity at the invariant level - ANCOVA model

Varijable / variables	Adjustend means (ispitanice.sta)					p-level sign.
	I grupa / Group 20-25 god. / years.	II grupa / Group 26-31 god. / years.	III grupa / Group 32-37 god. / years.	IV grupa / Group 38-44 god. / years.	F (df 1,2)	
MFLISK	81.2341	84.8613	93.1062	98.1230	6.5861	.0000
MFLPRK	29.8633	26.1220	24.0622	21.0610	6.3451	.0008
MFLPRR	152.8442	144.7500	139.2106	132.1330	7.1321	.0000
MFLZLP	76.7355	73.1206	66.0126	61.0306	5.8663	.0009
MFLPLK	29.0664	26.1001	22.0727	21.1445	5.6310	.0010
MRCSKL	6.2120	5.5135	3.7635	3.8261	4.7281	.0015
MRCZTL	15.0336	10.1066	7.1682	6.0061	4.0660	.0026
MRCDTL	18.9886	16.2235	14.2633	12.4338	3.1360	.0106
MBFTAP	34.9934	33.2614	32.8867	31.4236	1.3843	.2104
MBFTAN	26.1311	25.2466	23.6631	22.1406	1.8742	.0634

Najveći doprinos razlici između grupa na finalnom mjerenu (tabela 4), uz neutralizaciju razlika na inicijalnom mjerenu, imaju sve primjenjene varijable fleksibilnosti i repetitivne snage. Doprinos razlici između grupa nije ostvaren u varijablama brzine frekventnih pokreta, i to: tapping rukom – MBFTAP, čija je signifikantnost (.2104) i tapping nogom – MBFTAN, čija je signifikantnost (.6034), te se može prepostaviti da je to posljedica primjene eksperimentalnog kineziološkog programa. Kada su u pitanju motoričke sposobnosti može se takođe konstatovati da su kod sve četiri eksperimentalne grupe utvrđene statistički značajne razlike u većini primjenjenih motoričkih varijabli, ali su statistički najznačajniji efekti kinezioloških aktivnosti ostvareni kod prve dvije grupe ispitanica. Tu se prije svega misli na varijable fleksibilnosti trupa, ruku i ra-

in the initial measurement, it can be noted that there is statistical significance between group differences at the level of ($p = .000$). Therefore, applied experimental program has impacted positively on the transformation of most motor skills of respondents in treated groups.

The largest contribution to the difference between groups at the final measurements (Table 4), by neutralizing the difference in the initial measurement, has all applied variables of flexibility and repetitive strength. Contribution to the difference between the groups was not achieved in the variables of speed frequency movement, namely: hand tapping - MBFTAP, whose significance is (.2104) and foot tapping - MBFTAN, which whose significance is (.6034), and it can be assumed that this is a consequence of the applying the experimental kinesiology program. When it comes to motor skills it can also be concluded that in all four experimental groups were no statistically significant differences in most applied motor variables, but they are statistically the most significant effects of kinesiology activities achieved in the first two groups of respondents.

menog pojasa i varijable repetitivne snage trupa, ruku i ramenog pojasa.

Dobijeni rezultati istraživanja su u skladu sa rezultatima koje su dobili u svojim istraživanjima (Mikić i sar., 1978; Fučkar i sar., 1997; Kostić i sar., 2003; Đug i sar., 2007; Hadžić & Mikić, 2009; Pape i sar., 2010; Torlaković i sar., 2011; Mikić i sar., 2012), kojima su potvrđene statistički značajne promjene motoričkih sposobnosti (fleksibilnosti, repetitivne snage, koordinacije) žena, nakon provedenog kineziološkog tretmana.

ZAKLJUČAK

Eksperimentalni program primjenjenih kinezioloških aktivnosti proizveo je značajne efekte u transformaciji morfoloških karakteristika ispitanica (tjelesna masa, body mass index, obimi i potkožno masno tkivo) tretiranih eksperimentalnih grupa.

Najznačajniji statistički efekti kinezioloških aktivnosti (eksperimentalnog tretmana), ostvareni su kod prve i druge grupe ispitanica koje su hronološkog uzrasta 20 do 25 godina i 26 do 31 godine.

Dobijeni rezultati istraživanja su u okviru rezultata koje su u svojim istraživanjima dobili (Fučkar i sar., 1997; Baiyos i sar., 2006; Mikalački i sar., 2006; Arslan i sar., 2010; Strbad i sar., 2011; Koroljev i sar., 2011; Zrnić i sar., 2012; Mikić i sar., 2013), kojima su potvrđene pozitivne promjene morfoloških karakteristika žena nakon provedenog rekreativnog vježbanja.

Prezentirani rezultati ukazuju da je eksperimentalni program primjenjenih kinezioloških aktivnosti proizveo značajne transformacione efekte morfoloških karakteristika ispitanica kod tretiranih eksperimentalnih grupa.

Može se zaključiti da se motoričke sposobnosti ispitanica poboljšavaju u periodu od adolescencije do 30. godine života (Mikalački, 2006; Makivić i sar., 2007; Hadžić i sar., 2009; Pape i sar., 2010; Mikić i sar., 2012). Opadajući trend se očitava u cijelom posmatranom periodu od 30 – 44. godine života ispitanica.

Može se zaključiti da se fleksibilnost ispitanica održava i poboljšava vježbanjem od perioda adolescencije do 30. godine života. U periodu od 20. do 30. godine života ispitanica svi testovi pokazuju najbolje rezultate. Nakon ovog perioda u svim testovima, dolazi do manje, ili više, osjetnog pada rezultata sa manjim odstupanjima kod testova pretklon na klupici i prednoženje. Opadajući trend očitava se u cijelom posmatranom periodu od 30-44 godine života ispitanica. Nakon 37. godine život primjećuje se značajan pad svih rezultata testova fleksibilnosti i on se nastavlja sve do kraja posmatranog perioda, odnosno do 44 godine života, što je u skladu sa istra-

This primarily refers to the variable of flexibility of the torso, arms and shoulders and variable of repetitive strength of trunk, arms and shoulders.

The obtained research results are consistent with the results that have been achieved in their research (Mikic et al., 1978 Fučkar et al., 1997; Kostic et al., 2003; Đug et al., 2007; Hadzic & Mikic, 2009;Pope et al., 2010; Torlakovic et al., 2011; Mikić et al., 2012), with what they confirmed statistically significant changes in motor skills (flexibility, repetitive strength, coordination) of women, after applying the kinesiological treatment.

CONCLUSION

The experimental program of applied kinesiology activities produced significant effects in transformation of morphological characteristics of the patients (body weight, body mass index, circumferences and subcutaneous adipose tissue) of treated experimental groups.

The most statistically significant effects of kinetic activity (experimental treatment), were achieved in the first and second group of women who are chronological age from 20-25 and 26-31.

The results of research are in the frame of the results that were achieved in their studies (Fučkar et al., 1997; Baiyos et al., 2006; Mikalački et al., 2006; Arslan et al., 2010; Strbad et al., 2011; Korolev et al., 2011; Zrnić et al., 2012; Mikić et al., 2013), which have confirmed positive changes in the morphological characteristics of women after the recreational exercise.

The presented results show that the experimental program of applied kinesiology activities produced significant transformational effects of morphological characteristics of the patients treated with the experimental group. It can be concluded that motor skills of subjects improved during the period from adolescence to the age of 30 (which Mikalač, 2006; Makivić et al., 2007; Hadzic et al., 2009; Pope et al., 2010; Mikić et al., 2012). The downward trend is reflected in the whole observed period of 30 - 44 years old respondents.

It can be concluded that the flexibility of respondents maintains and improves the exercise period of adolescence to the age of 30. In the period from 20 to 30 years old respondents, all tests show the best results. After this period in all tests, there is less, or more, noticeable decreased results found with minor deviations at testing the reach over the bench and bending over. The downward trend is seen in fully observed period from 30 to 44 years old subjects. After the 37 years old, it is noticeable a significant decrease of all test results on flexibility and continues until the end of the observed period,

živanjima (Kostić i Zagorc 2005; Mikalački i sar., 2010; Mikić i sar., 2012). Ima li se u vidu da je trend opadanja motoričkih sposobnosti vrlo izražen ukoliko se ne radi na njihovom održavanju i razvijanju, onda i ne čude ovakvi rezultati i tendencija opadanja ovih sposobnosti sa povećanjem godina života.

Izjava autora

Autori pridonijeli jednakо.

Konflikt interesa

Mi izjavljujemo da nemamo konflikt interesa

LITERATURA / REFERENCES

- American Alliance for Health, Physical Education, Recreation and Dance (1989). *Physical best the AAHPERD guide to physical fitness education and assessment*. Reston, Va: AAHPERD.
- American College of Sports Medicine (ACSM) (2001). Appropriate intervention strategies for weightloss and prevention of weight regain for adults. *Med Sci Sports Exera*; 33: 2145-56.
- Arslan, F., Cakmakci, E., Taskin, H., Cakmakci, O., Cecilia, G... (2010). *Evaluation of the effects of exercise programma on aome fitness parametars ana weight loss at middle aged perimenopause sedentary women*. Zbornik radova, Fakultet sporta i fizičkog vaspitanja, Beograd.
- Bayios, IA., Bergeles, NK., Apostolidis, NG., Noutsos, KS., & Koskolou, M.D. (2006). Anthropometric, body composition and somatotype differences of Greek elite female basketball, volleyball and handball players. *J Sport Med Phys Fitness*. 46 (2):271-80.
- Can, F., Yilmaz, I., & Erden, Z. (2004). Morphological characteristics and performance variables of women soccer players. *J. Strenght Cond Res.* 18 (3): 480-485.
- Dug, M., & Mikić, B. (2007). Uticaj step aerobika na transformaciju antropometrijskih karakteristika i motoričkih sposobnosti studenata, "Sport u 21 vijeku", Herceg Novi- Bijela, *Sport Mont str.* 129-133. [In Bosnian]
- Fučkar, K. (1997). Promjene nekih morfoloških i motoričkih karakteristika žena srednje dobi pod uticajem sistematskog treninga aerobike. (Zbornik radova). Zagreb. Fakultet fizičke kulture. [In Croatian]
- Hadžić, S., Mikić, B., Mehinović, J., & Dug, M. (2009). Uticaj programskih sadržaja aerobika na regulaciju pretilosti i razvoj fleksibilnosti kod studentkinja Univerziteta u Tuzli. Beograd. V međunarodna konferencija (*Menadžment u sportu*). [In Bosnian]
- Hazar, S., & Kurt, S. (2010). *The effect of eight-mount exercise program on bone density and some Physical characteristics in sedentary women*. Zbornik radova. Beograd: Fakultet sporta i fizičkog vaspitanja.
- Korovljev, D., Mikalački, M., & Čokorilo, N. (2011). *Starosna dob i tjelesna kompozicija fizički aktivnih žena*. VII Kongres Crnogorske sportske akademije. VIII Medunarodna naučna konferencija. Časopis "Sport Mont", 26-27/IX. Podgorica. [In Serbian]
- Makivić, B., Đorđević, M., Macura, M., & Sojiljković, S. (2007). *Rekreativni trening žena u teretani-efekti na zdravlje, motoričke i funkcionalne sposobnosti*, Zbomik radova, 13, Beograd: Fakultet sporta i fizičkog vaspitanja. [In Serbian]
- Mikalački, M. (2006). *Efekti primjene različitih modela vježbanja na neke motoričke sposobnosti i morfološke karakteristike žena*, Homo Sportikus, 2, 2732, Sarajevo. [In Serbian]
- Mikić, B. (2005). *Wellness & Fitness*. Mostar: Nastavnički fakultet Univerziteta "Džemal Bijedić".
- Mikić, B., Biberović, A., Aghbar, S., Makivić, B., Đorđević, M., Macura, M., & Sojiljković, S. (2007). *Rekreativni trening žena u teretani-efekti na zdravlje, motoričke i funkcionalne sposobnosti*, Zbomik radova, 13, Beograd: Fakultet sporta i fizičkog vaspitanja. [In Serbian]
- Mijatović, V. (2012). Razlike u gipkosti kod žena od adolescencije do zrele dobi. Vlašić. V Međunarodni simpozij "Uloga sporta u očuvanju zdravlja". (Zbornik radova). [In Bosnian]
- Mikić, B., Bratović, V., Kostovski, Ž., Vujović, D., Šarić, E. (2013). The difference in the structure of the body in women adolescence to adulthood. Sarajevo. *HEALTH MED*. Volume 7. Number 9. [In Serbian]
- Mikić, B.(1978). *Programiranje rekreativnih aktivnosti osoba poslije 35-te godine*, Sportnomedicinske objave, (10-12), 509-512. [In Bosnian]
- Mitić, D. (2001). *Rekreacija*, Fakultet sporta i fizičkog vaspitanja, Beograd. [In Serbian]
- Pape, O., Pape, K., Gevat, C., Kaya, M., & Yildiz, K. (2010). *The effects of eight weeks basic step aerobic trainings on physical ana motoric abilitis of 30-35 years aged sedentary women*, Zbomik radova, Fakultet sporta i fizičkog vaspitanja, Beograd.

that is up to 44 years of age, which is in line with research (Kostic and Zagorc 2005; Mikalački et al., 2010; Mikić et al., 2012). Having in mind that the trend of decreasing in motor skills is very strong unless it is done more on their maintenance and development, then it is no surprise for these results and the tendency of decreasing of these abilities with increasing age.

Author's statement

The authors contributed equally.

Conflict of interest

We declare that we have no conflict of interest

- Strbad, M., Pehar, M., & Zenić, N. (2011). Diferencijalni uticaj individualnog i grupnog vježbanja na promjene u morfološkim mjerama kod odraslih žena. Bihać. II Internacionalni simpozij "Sport, turizam i zdravlje" (Zbornik radova). [In Bosnian]
- Torlaković, A., Krupalija, E., & Čaušević, N. (2011). Procjena nivoa nekih motoričkih sposobnosti kod žena u starijoj životnoj dobi po uticajem kombiniranih kinezioloških programa. Bihać. II Internacionalni simpozij "Sport, turizam i zdravlje" (Zbornik radova).
- Zrnić, R. (2012). Nivoi transformacionih promjena antropoloških dimenzija žena pod uticajem različitih modela sportsko rekreativnih aktivnosti. (*Unpublished Doctorial Thesis*). Banja Luka: Fakultet fizičkog vaspitanja i sporta. [In Serbian]

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Short notice

HIJERARHIJSKO STRUKTURIRANJE EKSPERTNOG MODELA ZA PODUKU SKIJAŠKOG OSNOVNOG ZAVOJA

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Sažetak: S ciljem formiranja hijerarhijske klasifikacije ekspertnog modela najvažnijih metodičkih vježbi za poduku osnovnog zavoja, te utvrđivanja razlike među skijaškim stručnjacima različitog stupnja skijaškog obrazovanja, provedeno je istraživanje na ukupnom uzorku od 307 skijaških stručnjaka iz različitih zemalja. Zadatak ispitanika je bio da ispunjavanjem online ankete po važnosti rangiraju formirani model najvažnijih metodičkih vježbi za poduku brzog vijuganja. Ekspertni model najvažnijih metodičkih vježbi obuhvaćao je 6 varijabli: ZBAVS (zavoj k brijevu aktivnim vođenjem skija), ZBOUR (zavoj k brijevu i odraz u raspluženje), ŠTV (štapovi na vratu), ŠTUP (štapovi u predručenju), OZSP (osnovni zavoj s pljeskom), AVOZ (avioni osnovnog zavoja). Radi ispitivanja statističke značajnosti razlika u rangiranju metodičkih vježbi za poduku osnovnog zavoja, ispitanici su podijeljeni temeljem stupnja skijaškog obrazovanja kojeg posjeduju podijeljeni u tri grupe. U skladu s postavljanim ciljem istraživanja, izračunate su vrijednosti sume ranga (ΣR) vrednovanja najvažnijih metodičkih vježbi, neparametrijski analogni post-hoc Kruskal-Walisov test (H), te pripadni empirijski nivo signifikantnosti (p). Dobivene su statistički značajne razlike između vrijednosti rangiranja najvažnijih metodičkih vježbi za poduku osnovnog zavoja ($H=138,62$; $p<0,001$). Na osnovu dobivenih vrijednosti sume ranga u vrednovanju važnosti primjene metodičkih vježbi i utvrđene statistički značajne razlike među njima, formirana je hijerarhijska klasifikacija. Ispitivanjem statističke značajnosti razlika među skijaškim stručnjacima različitog stupnja skijaškog obrazovanja, višestruka statistički značajna razlika nije utvrđena. Dobiveni rezultati ovoga istraživanja omogućuju precizne i znanstveno utemeljene metodske postavke za poduku skijaškog osnovnog zavoja. Time se otvaraju pravci za provedbu budućih istraživanja u vidu konstrukcije mjernih instrumenata čija bi primjena u praksi trebala omogućiti kvalitetniju selekciju, te izbor modaliteta metodičkih vježbi za poduku alpskih skijaša različitog uzrasta i razine skijaških predznanja.

Ključne riječi: hijerarhijska klasifikacija, skijaški stručnjaci, osnovni zavoj.

HIERARCHICAL CLASSIFICATION METODICAL MODEL FOR TEACHING BASIC SKI TURN

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Abstract: With the goal to form the hierarchical classification of the most important methodical exercises for teaching basic ski turn in ski schools and test differences between ski experts based on their different level of skiing education, there was conducted a survey on the total sample of 307 ski experts from different countries. Through the filling out the online survey they tried to distinguish the importance of the formed model of the most important methodical exercises for teaching basic ski turn. Expert model of the most important methodical exercises captured 6 variables: uphill turn and jumping into snowplough, basic turn with hand sideways, basic turn with clapping, ski poles in front, ski poles on neck, uphill turn with active ski guiding. In order to investigate the statistic meaning of differences in ranking the methodical exercises for teaching basic ski turn, participants are divided into three groups based on the degree of skiing education they posses. In relation to above mentioned, sums of ranks (ΣR) of the most important methodical exercises for teaching basic ski turn have been calculated. Using non-parametric analogue post-hoc analysis, i.e. Kruskal-Wallis test (H-test) and appropriate empiric level of significance (p), statistic significance of sums of ranks (ΣR) of the most important methodical exercises for teaching basic ski turn have been tested. Significant difference between the value of ranking the most methodical exercises have been obtained ($H=138,62$; $p<0,001$). Those variables which were not different in statistically significant way according to sums of rank were classified in one significant group, while variables which showed statistically significant difference were classified separately. Multiple statistically significant difference based on different degree ski education between the ski experts were not obvious. The results of this study provide an accurate and scientifically based methodological settings for teaching basic ski turn. This opens the directions for future research in the form of construction of measuring instruments whose application in practice should allow better selection and choice of modalities methodical exercises for training alpine skiers of different ages and levels of ski prior knowledge.

Key words: hierarchical classification, ski experts, basic ski turn.

Uvod

Usvajanje i savladavanje različitih tehnika alpskog skijanja je veoma kompleksan proces. Uvjetovan je evo-lucijom razvoja skijaške opreme, uvjetima u kojima se proces učenja odvija, motivaciji i adekvatnoj skijaškoj opremi. Između ostalog ovisi o iskustvu i metodama rada kojeg skijaški stručnjaci različitog stupnja skijaške izobrazbe u radu s polaznicima različitih skijaških pred-znanja primjenjuju. Kao rezultat toga brojni autori iz različitih skijaških nacija daju svoje predodžbe, specifične podjele i modele poučavanja pojedinih skijaških tehnika u suvremenim programima škole skijanja (Feinberg - Densmore, L., 2000; Jurković, N. i Jurković, D., 2003; Matković, Ferenčak i Žvan, 2004; Fry, 2006; Murovec 2006; Anderson, 2007; Puškarić, 2010; Ilić, B., Ropret, i Ilić, M., 2010; Lešnik i Žvan, 2010). Jedan od novijih modela je direktni put učenja gdje se obuka vrši pomoću postepenog produžavanja dužine skije koristeći isključivo elemente paralelne skijaške tehnike (Murovec, 2006). Ipak, najrašireniji i najpopularniji metodički pristup u poduci alpskih skijaša je onaj u kojem se koristi kombinacija elementa različitih skijaških tehnika (Lešnik i Žvan, 2010). Programom škole skijanja omogućava se i ubrzava proces svladavanja skijaških znanja. Zadržavajući metodički princip postupnosti, proces obuke alpskih skijaša potrebno je provoditi metodskim slijedom od laksih, prema težim, odnosno složenijim skijaškim elementima. Iste zakonitosti vrijede u primjeni metodičkih vježbi koje se koriste za njihovu obuku, stoga skijaški elementi i metodičke vježbe trebaju dolaziti jedni za drugima u logičnom metodskom slijedu. Prvi lik škole skijanja u čijoj izvedbi se naizmjenično koriste elemen-ti paralelne i plužne skijaške tehnike koristeći pri tome konstrukcijske značajke „carving“ skija je osnovni zavoj. Obuhvaća veći broj specifičnih skijaških znanja kojima se dinamički povezanim zavojima uspješno mogu savla-dati strmije skijaške staze. O stupnju usvojenosti i kvaliteti izvedbe osnovnog zavoja ovisi daljnji tijek procesa usvajanja budućih skijaških znanja (Kuna, 2012.), stoga ga se može nazvati jednim od temeljnih likova osnovne škole skijanja. Oslanjajući se na rezultate istraživanja u kojem je postavljen ekspertni model najvažnijih skijaš-kih elemenata programa osnovne škole skijanja (Kuna, 2012) i formiranja ekspertnog modela za poduku osnov-nog zavoja (Kuna, 2013), javila se ideja za formiranjem hijerarhijske klasifikacije ekspertnog modela za njegovu poduku. U svezi s navedenim, proizašli su sljedeći ciljevi ovog istraživanja, a to su: a) formiranje hijerarhijske klasifikacije ekspertnog modela za poduku osnovnog zavo-ja, b) utvrđivanje razlike između učitelja i demonstratora

INTRODUCTION

Acquiring and mastering different techniques of alpine skiing is a very complex process. It is conditioned by the evolution of skiing equipment, conditions in which skiing learning process is performed, as well as motivation and adequate skiing equipment. Besides this, it depends on the experience and work methods used by skiing experts of different levels of education on the learners of different levels of skiing knowledge. As a result, numerous authors from different skiing nations gave their concepts, specific classifications and teaching models of certain skiing techniques in contemporary skiing schools programmes (Feinberg - Densmore, L., 2000; Jurković and Jurković, 2003; Matković et al., 2004; John, 2006; Murovec, 2006; Anderson, 2007; Puškarić, 2010; Božidar et al., 2010; Lešnik and Žvan, 2010). One of newer models is the direct learning model, in which the education is performed by gradual elongation of skis' length, using exclusively the elements of parallel skiing technique (Murovec, 2006). However, the most used and most popular methodical approach in the education of alpine skiers is the one which uses combination of different skiing techniques elements (Lešnik and Žvan, 2010). The skiing school programme enables and accelerates the acquisition programme of skiing techniques. Maintaining the methodical principle of progressivity, the alpine skiers training process needs to be performed in a methodologic sequence, from the easiest ones towards the most difficult ones, that is, more complex skiing elements. Same laws are valid for the application of methodical exercises that are used for their training, therefore skiing elements and methodical exercises should follow in a logical methodological sequence. The first element of skiing school, in whose performance the elements of parallel and snow plow technique are used, while using the construction characteristics of "carving" skis, is the basic turn. It includes a larger amount of specific skiing knowledge that uses dynamically connected turns in order to successfully master steeper skiing slopes. The further process of skiing knowledge acquisition depends on the degree of acquisition and quality of basic turn performance (Kuna, 2012), therefore it can be defined as one of the basic elements of elementary skiing school. Based on the research results, in which expert model of the most important skiing elements of skiing elementary school programme was set (Kuna, 2012), and expert model of basic turn teaching (Kuna, 2013), an idea of forming hierarchical classification of expert teaching model occurred. Related to this, the following aims of this research were set: a) forming the hierarchical classification of basic turn teaching expert model, b) determining the difference between skiing teachers and assistants of different profes-

skijanja različite razine stručnosti u rangiranju najvažnijih metodičkih vježbi za poduku osnovnog zavoja

METODE RADA

Istraživanje se provelo u nekoliko faza. Najprije su napravljeni video zapisi demonstracije 6 najvažnijih metodičkih vježbi za poduku osnovnog zavoja. Potom je uslijedila online priprema anketnog upitnika i postavljanje na specijalizirani server namijenjen elektronskom prikupljanju i analizi podataka na globalnoj razini. Radi lakšeg razumijevanja, najvažnije metodičke vježbe za poduku osnovnog zavoja su opisane i prikaze pomoću gif uratka. Nakon toga je putem e-maila upućeno pismo namjere s molbom za sudjelovanje u istraživanju, te link s adresom pristupa popunjavanju ankete na mnogobrojne e-mail adrese učitelja i demonstratora skijanja različite razine stručnosti iz ZUTS-a Slovenije, HZUTS-a Hrvatske i ATUS-a Bosne i Hercegovine. Prikupljanje podataka je trajalo ukupno 6 mjeseci. Radi utvrđivanja identifikacije i iskustva u radu s alpskim skijašima, ispitanici su uvodni dio upitnika ispunili upisivanjem teksta i brojčane vrijednosti u predviđeno polje. Odabirom ponuđenih odgovora na skali od 1 do 6 izvršeno je rangiranje prikazanih metodičkih vježbi za poduku osnovnog zavoja. Nakon pregledavanja varijabli identifikacije i klasifikacije ispitanika koji su pristupili online ispunjavanju ankete, za obradu podataka odabrani su rezultati od 307 ispitanika. Od toga je bilo 119 slovenskih, 128 hrvatskih i 60 bosansko-hercegovačkih učitelja i demonstratora skijanja različite razine stručnosti, koji su u potpunosti ispunili anketu. Njihovi rezultati rangiranja ekspertnog modela 6 najvažnijih metodičkih vježbi za poduku osnovnog zavoja uvjetovali su formiranje hijerarhijske klasifikacije. Da bi se utvrdilo postoje li statistički značajne razlike između ukupnog uzorka ispitanika, obzirom na razinu skijaškog obrazovanja kojeg posjeduju, ispitanici su podijeljeni u tri skupine. Prvu skupinu su činili skijaški stručnjaci vrhunskog skijaškog obrazovanja (SV): hrvatski, slovenski i bosansko-hercegovački članovi demo tema i demonstratori skijanja, te slovenski učitelji skijanja III. razine N=78. Drugu skupinu ispitanika su činili skijaški stručnjaci naprednog skijaškog obrazovanja (SN): hrvatski učitelji skijanja, te slovenski i bosansko-hercegovački učitelji skijanja II. razine N=128. Treću skupinu ispitanika su činili skijaški stručnjaci osnovnog skijaškog obrazovanja (SO), hrvatski pripravnici učitelja skijanja, te slovenski i bosansko-hercegovački učitelji skijanja I. razine N=101. Ekspertni model najvažnijih metodičkih vježbi za poduku osnovnog zavoja je činilo 6 vježbi: ZBAVS (zavoj k brijevu aktivnim vođenjem ski-

sionalism levels in ranging the most important methodical exercises for basic turn teaching.

METHODS

The research was conducted in several phases. Firstly, the videos of 6 most important basic turn teaching methodical exercises were filmed. Then, the online setting of questionnaire and uploading on the specialized server used in global electronic data collection and analysis was conducted. For easier understanding, the most important methodical exercises for basic turn teaching were described and displayed via gif image format (Graphics Interchange Format). After that, a letter of intent with a proposal of participation in the research was sent via email, and the link with the questionnaire address was sent to many e-mail addresses of skiing teachers and assistants of different professionalism levels from the Ski Associations of Slovenia, Croatia and Bosnia and Herzegovina. The data collection lasted for 6 months. With the aim of determining identification and experience in the work with alpine skiers, the examinees filled in first part of the questionnaire by writing in text and numerical value in the provided field. The choice of the offered answers on the scale from 1 to 6 ranked the displayed methodological exercises for basic turn teaching. After the inspection of the identification and classification variables for the examinees that filled the online questionnaire, the results of 307 examinees were chosen for data processing: 119 Slovenian, 128 Croatian and 60 Bosnian-Herzegovinian skiing teachers and assistants of different professionalism levels that filled in the entire questionnaire. Their results of ranking expert model of six most important methodological exercises for basic turn teaching conditioned the forming of hierarchical classification. To determine the existence of statistically significant differences among the total number of examinees, regarding the level of skiing education, the examinees were divided into 3 groups. The first group consisted of skiing experts of elite skiing education (SE): Croatian, Slovenian and Bosnian-Herzegovinian members of skiing teams and skiing demonstrators, and Slovenian skiing teachers of 3rd level (N=78). The second group of examinees consisted of skiing experts of advanced skiing knowledge (SA): Croatian skiing teachers and Slovenian and Bosnian-Herzegovinian skiing teachers of 2nd level N=128. The third group of examinees consisted of skiing experts of basic skiing education (SB), Croatian assistants of skiing teachers, and Slovenian and Bosnian-Herzegovinian skiing teachers of 1st level N=101. The expert model of the most important methodological exercises for basic turn teaching consisted of six exercises: TTHAS (turn towards the hill with active

ja), ZBOUR (zavoj k brijegu i odraz u raspluženje), ŠTV (štapovi na vratu), ŠTUP (štapovi u predručenju), OZSP (osnovni zavoj s pljeskom), AVOZ (avioni osnovnog zavoja). U skladu s postavljenim ciljevima istraživanja: a) formiranje hijerarhijske klasifikacije ekspertnog modela za poduku osnovnog zavoja, b) utvrđivanje razlike između učitelja i demonstratora skijanja različite razine stručnosti u rangiranju najvažnijih metodičkih vježbi za poduku osnovnog zavoja izračunate su vrijednosti sume ranga (ΣR) vrednovanja najvažnijih metodičkih vježbi, neparametrijski analogni post-hoc Kruskal-Wallisov test (H), te pripadni empirijski nivo signifikantnosti (p) radi ispitivanja statistički značajne razlike u njihovoj klasifikaciji.

REZULTATI I RASPRAVA

Statistički značajna razlika između vrijednosti rangiranja najvažnijih metodičkih vježbi za poduku osnovnog zavoja ($p<0,001$) očituje se prema dobivenim vrijednostima Kruskal-Wallisovog testa (H-test) i pripadnog empirijskog nivoa signifikantnosti (p) prikazanim u Tablici 1. Pomoću neparametrijske analognog post-hoc analize, utvrđena je statistički značajna razlika među vrijednostima sume ranga metodičkih vježbi ZBAVS, ZBOUR, ŠTUP, OZSP i AVOZ za $p=0,00$. Također, statistički značajna razlika utvrđena je među vrijednostima sume ranga vježbi ZBOUR, ŠTV i ŠTUP, te između vježbi ŠTUP, OZSP i AVOZ, te operatora ŠTUP i OZSP za $p=0,00$.

Tablica 1. Suma ranga najvažnijih metodičkih vježbi za poduku osnovnog zavoja (ΣR), vrijednosti Kruskal-Wallisovog testa (H-test) i pripadni nivo signifikantnosti (p) / **Table 1.** Rank sum of the most important methodological exercises for basic turn teaching (ΣR), non-parametric analogue post-hoc Kruskal-Wallis test (H) and corresponding empirical level of significance (p)

METODIČKE VJEŽBE ZA PODUKU OSNOVNOG ZAVOJA / METHODICAL EXERCISES FOR BASIC TURN TEACHING						
ZBAVS / TTHAS	ZBOUR / TTHTP	ŠTV / SPN	ŠTUP / SPE	AVOZ / BTC	ΣR	
ZBAVS / TTHAS					752	
ZBOUR / TTHTP	0.00				935	
ŠTV / SPN	1.00	0.00			728	
ŠTUP / SPE	0.00	1.00	0.00		947	
AVOZ / BTC	0.00	0.00	0.00	0.00	1132	
OZSP / BTA	0.00	0.30	0.00	0.61	0.36	1035
$H=138.62; p<0.001$						

Prema dobivenim značajnostima razlike u rangiranju važnosti primjene pojedinih metodičkih vježbi za poduku osnovnog zavoja, a na osnovu vrijednosti sume ranga, formirana je njihova hijerarhijska klasifikacija. Metodička vježba koji ima najveću važnost u poduci

skiis), TTHTP (turn towards hill and take off into plow), SPN (ski poles on neck), SPE (ski poles extended), BTC (basic turn with clap), BTA (basic turn airplanes). In concordance with the set research aims: a) forming the hierarchical classification of basic turn teaching expert model, b) determining the difference between skiing teachers and assistants of different professionalism levels in ranking the most important methodic exercises for basic turn teaching, the rank sum (ΣR) of the most important methodological exercises evaluation was calculated, as well as non-parametric analogue post-hoc Kruskal-Wallis test (H) and corresponding empirical level of significance (p), with the aim of examining the statistically significant levels of their classification difference.

RESULTS

The statistically significant difference between the values of ranking the most important methodical exercises for basic turn teaching ($p<0.001$) was revealed through the obtained results of Kruskal-Wallis test (H-test) and corresponding empirical level of significance (p), shown in Table 1. Using the non-parametric analogue post-hoc analysis, a statistically significant difference between the rank sum of methodological exercises TTHAS, TTHTP, SPE, BTC and BTA was determined for $p=0.00$. Also, statistically significant difference was determined between the rank sum of TTHTP, SPN and SPE exercises, and between the SPE, BTC and BTA exercises, and operators SPE and BTC for $p=0.00$.

According to the obtained difference significances in ranking the importance of applying certain methodological exercises in basic turn teaching, and based on the rank sum value, the hierarchical classification was formed. Methodical exercise that is the most important

osnovnog zavoja je *AVOZ*. Pomoću vježbe *AVOZ* skijaš izvodi osnovni zavoj imitacijom aviona na način da tijekom paralelnog zavoja k briješu vanjsku ruku spušta prema vanjskoj skiji dok unutarnju ruku podiže odručenjem u zrak. Visoka vrijednost ove metodičke vježbe je u tome što omogućava bolje uspostavljanje ravnotežnog položaja i opterećenja nad vanjskom skijom tijekom izvedbe zavoja k briješu čime se olakšava odraz u raspluženje i prelazak u novi zavoj. (Prikaz 1).



Prikaz 1. Avioni osnovnog zavoja - *AVOZ*

Na drugome mjestu je vježba *OZSP*. Vrijednost ove vježbe se ogleda u tome što skijaš u fazi otvorenog zavoja k briješu šake obiju ruku postavlja na koljena potiskujući ih prema zavodu čime pospješuje kružna, vertikalna i bočna gibanja koljena, te na taj način efikasnije spušta centar težišta tijela. Raspluženjem unutarnje skije, skijaš prelazi iz niskog u visoki skijaški stav, istodobno izvodi pljesak s obje ruke koje podiže ispred i iznad razine glave čime je olakšan odraz i pravovremeni prelazak skija u novi zavoj (Prikaz 2).



Prikaz 2. Iz zavoja k briješu prelazak u raspluženje pljeskom s rukama (*OZSP*).

Na trećem mjestu po važnosti su metodičke vježbe *ŠTUP* i *ZBOUR*. U izvedbi vježbe *ŠTUP* skijaš paralelno postavljene štapove drži u predručenju. Glavno obilježje ove metodičke vježbe je uspostavljanje boljeg ravnotežnog položaja i centra opterećenja na skijama, čime se sprječavaju negativni efekti zaostajanja tijela za skijama i nagnjanje skijaša prema nazad što je jedna od najčešćih greški tijekom izvedbe osnovnog zavoja (Prikaz 3).

in teaching basic turn was BTA. This exercise helps the skier to perform the basic turn by imitating aeroplane: during the parallel turn towards the hill, he lowers his outer arm towards the ski, while the inner arm is being lifted up. The high value of this methodological exercise is due to better achievement of balance and pressure on the outer ski during performance of turn towards the hill, what facilitates obtaining plow position and passing into the new turn (Image 1).

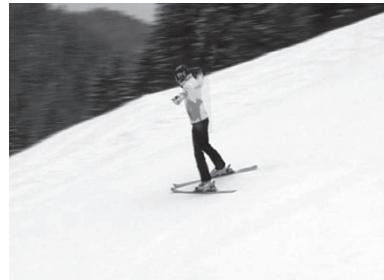


Image 1. BTA - basic turn airplanes

Exercise BTC is at the second position. This exercise enables the skier to put the fists of both hands on his knees, pushing them towards the turn, in the phase of open turn towards the hill, what facilitates circular, vertical and lateral knee movement, more efficiently lowering the body mass centre. By plowing the inner ski, the skier goes from low to high skiing position, simultaneously performing a clap with both hands that are lifted above and in front of the head, what facilitates take off and timely passing of the skis to the following turn (Image 2).

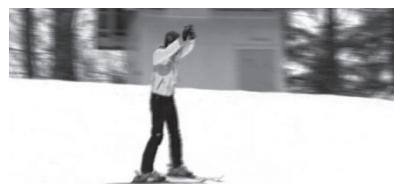


Image 2. BTC - basic turn with clap

Third most important exercises are SPE and TTHTP methodological exercises. While performing the SPE exercise, the skier holds the parallel ski poles frontally extended. The main characteristic of this methodical exercise is the achievement of better balance and weight centre on the skis, what prevents the negative effect of body lingering after the skis and skier leaning back, what is one of the most common errors during the basic turn performance (Image 3).



Prikaz 3. Štapovi u predručenju (ŠTUP)

Pomoću vježbe ZBOUR skijaš izvodi kombinaciju otvorenih zavoja k brijegu i odraza u raspluženje, najprije u jednu, pa potom u drugu stranu kretanja (Prikaz 4).

Faze prelaska iz otvorenog zavoja k brijegu u raspluženje su temeljne strukturalne jedinice koje čine uspješnu izvedbu osnovnog zavoja. Pomoću njihove parcijalne i naizmjenične izvedbe olakšava se usvajanje i povezivanje ostalih strukturalnih jedinica, te osnovnog zavoja u cijelosti.



Prikaz 4. Zavoji k brijegu s naizmjeničnim odrazom u raspluženje (ZBOUR)

Na četvrtom mjestu su ZBAVS i ŠTV. Uvježbavanje zavoja k brijegu aktivnim vođenjem skija - ZBAVS čini jedan od glavnih preduvjeta za daljnje usvajanje ne samo osnovnog zavoja, nego i ostalih elemenata unutar osnovne i napredne škole skijanja. Iz spusta koso ili ravno na paralelno postavljenim skijama, ovisno o skijaševim motoričkim sposobnostima i skijaškim predznanjima, pokretom oba koljena prema naprijed, dolje i u smjeru zavoja skijaš se iz visokog, spušta u niži položaj, te postepeno opterećuje i uspostavlja ravnotežu na vanjskoj skiji. Pomoću tzv. kružnih, vertikalnih i bočnih gibanja, paralelno postavljene skije se aktivno vode u polukružni luk zavoja u zavoj k brijegu koji traje sve dok skije ne dođu paralelno s padnom linijom. Ovom metodičkom vježbom se uvježbavaju istovremeni kružni, vertikalni i bočni pokreti koljenima o čemu u konačnici ovisi uspješno upravljanje skija (Prikaz 5).



Image 3. SPE - ski poles extended

In TTHTP exercise the skier performs the combination of open turns toward the hill and take offs into plow, in one and then in the other movement direction (Image 4).

The phases of passing from opened slope towards hill to plowing are the basic structural units that make a successful basic turn performance. With the help of their partial and alternate performance, the achievement and connection of the remaining structural units, as well as basic turn in total, is facilitated.



Image 4. TTHTP - turn towards hill and take off into plow

Fourth most important exercises are TTHAS and SPN. Practising the slope towards the hill by active skis guidance – TTHAS, makes one of the main preconditions of the further acquisition of not only basic turn, but also the remaining elements within the basic and advanced skiing school. From slant or straight downhill on parallel skis, depending on the skier's motor abilities and skiing knowledge, by moving both knees forward, down and in the slope direction, the skier lowers himself from high into lower position, and gradually burdens and balances on the outer ski. Helped by the so-called outer, vertical and lateral movement, the parallel skis are actively directed towards the semi-circular arch of the turn and the turn towards the hill that lasts until the skis are parallel to the line of falling. This methodical exercise practices simultaneous circular, vertical and lateral knee movements, that influence the successful ski directing (Image 5).



Prikaz 5. Zavoj k briježu aktivnim vodenjem skija (ZBAVS)

Pomoću vježbe ŠTV skijaš osnovni zavoj izvodi držeći paralelno postavljene štapove na ramenima potiskujući tijekom izvedbe otvorenog zavoja k briježu vanjsko rame niz padinu u svrhu boljeg uspostavljanja ravnotežnog položaja i opterećenja vanjske skije (Prikaz 6).



Prikaz 6. Štapovi na vratu (ŠTV)

U Tablici 2. su prikazani rezultati Kruskal-Walisovog testa (H-test) i pripadnog empirijskog nivoa signifikantnosti (p) u ispitivanju statističke značajnosti razlike između vrijednosti aritmetičkih sredina sume ranga (AS ΣR) najvažnijih metodičkih vježbi za poduku osnovnog zavoja tri grupe skijaških stručnjaka. Prema dobivenim rezultatima vidljivo je da ne postoji statistički značajna razlika među njima. Na osnovu toga može se konstatirati kako su skijaški stručnjaci unatoč različitom stupnju skijaškog obrazovanja kojeg posjeduju i iskustvu u radu sa skijašima različitih skijaških predznanja činili homogenu skupinu koja je na podjednak način po važnosti klasificirala metodičke vježbe za poduku osnovnog zavoja.

Dobiveni rezultati hijerarhijske klasifikacije ekspertnog modela metodičkih vježbi za poduku osnovnog zavoja, gledano na hipotetskoj razini, pridonose boljem razumijevanju odnosa i definiranju temeljnih metodskih postupaka u procesu poduke alpskih skijaša. Glavno ograničenje ovog istraživanja se ogleda u nemogućnosti kontroliranja ispitanika tijekom online ispunjavanja ankete, zbog čega se ne može konstatirati kako su njihovi odgovori u cijelosti bili realni. Dobiveni rezultati otvaraju mogućnost provedbe budućih istraživanja kojima bi bilo zanimljivo definirati karakteristične pogreške te najučinkovitije vježbe za njihovu korekciju prilikom



Image 5. TTHAS - turn towards the hill with active skiis

The SPN exercise helps the skier to perform the basic turn by holding the parallel ski poles on his shoulders, by pushing the outer shoulder down the hill during the open turn towards the hill performance, with the aim of achieving better balance and outer ski burdening (Image 6).



Image 6. SPN - ski poles on neck

Table 2 shows the results of Kruskal-Wallis test (H-test) and the corresponding empirical level of significance (p) in the examination of statistical difference significance between the values of arithmetic means of rank sum (AS ΣR) of the most important methodical exercises for basic turn teaching for three groups of skiing experts. According to the obtained results, it is obvious that there was no statistically significant difference. Based on this, it can be determined that the skiing experts, in spite of the different degree of skiing education and experience in working with skiers of different knowledge, made up a homogeneous group that classified the basic turn methodical exercises equally. The obtained results of hierarchical classification of the expert model of basic turn teaching methodic exercises, in a hypothetical sense, contribute to better understanding of relations and the definition of basic methodical procedures in the process of alpine skiers education. The main limit of this research is the lack of possibility to control the examinees during the online questionnaire, so it cannot be claimed that their results were entirely realistic. The obtained results open the possibility of executing future research that could define the usual errors and the most efficient exercises for their correction while learning basic turn.

Also, a need for the construction of measuring in-

Tablica 2. Vrijednosti aritmetičkih sredina sume ranga u vrednovanju najvažnijih metodičkih vježbi za poduku osnovnog zavoja (AS ΣR), Kruskal-Wallisov (H) test i pripadni empirijski nivo signifikantnosti (p) radi ispitivanja razlike između tri grupe skijaških stručnjaka osnovnog skijaškog obrazovanja (SO), naprednog skijaškog obrazovanja (SN) i vrhunskog skijaškog obrazovanja (SV). / **Table 2.** Values of arithmetic means of rank sum (AS ΣR) of the most important methodical exercises for basic turn teaching, Kruskal-Wallis test (H-test) and the corresponding empirical level of significance (p) in the examination of statistical difference significance between the skiing experts of elite skiing education (SE), skiing experts of advanced skiing knowledge (SA) and skiing experts of basic skiing education (SB)

Vježbe osnovnog zavoja / Methodical Exercises for Basic Turn Teaching	SO /	SN / SA	SV / SE	H	p
	AS ΣR	AS ΣR	AS ΣR		
ZBAVS / TTHAS	159.94	159.86	141.99	2.94	0.22
ZBOUR / TTHTP	157.31	154.29	151.07	0.23	0.89
ŠTV / SPN	154.15	157.68	149.22	0.53	0.76
ŠTUP / SPE	164.07	143.43	159.61	3.33	0.18
AVOZ / BTC	147.54	146.53	168.46	4.19	0.12
OZSP / BTA	144.78	158.97	154.82	1.29	0.52

usvajanja osnovnog zavoja. Također se javlja potreba za konstrukcijom mjernih instrumenata čija bi primjena u praksi trebala omogućiti kvalitetniju selekciju, te izbor modaliteta treninga i trenaažnih vježbi u procesu poduke alpskih skijaša različitog uzrasta i razine skijaških predznana.

ZAKLJUČAK

Generalnim osvrtom na dobivene rezultate provedenog istraživanja s ciljem formiranja hijerarhijske klasifikacije ekspertnog modela metodičkih vježbi za poduku osnovnog zavoja, te ispitivanja statističke značajnosti razlika između tri grupe skijaških stručnjaka različitog stupnja obrazovanja u njegovom vrednovanju, može se konstatirati kako dobivene spoznaje na generalnom nivou omogućuju relativno kvalitetnije planiranje procesa poduke alpskih skijaša. Usprkos različitom stupnju skijaškog obrazovanja kojeg ispitnici koji su formirali hijerarhijsku klasifikaciju ekspertnog modela za poduku osnovnog zavoja posjeduju, razlika među njima nije utvrđena. Na temelju toga se može zaključiti kako su činili homogenu skupinu koja je prepoznaala važnost i doprinos pojedinačne vježbe u metodici poduke alpskih skijaša. Budući ne postoje radovi slične tematike, ovo istraživanje ima posebnu vrijednost koja se ogleda u postavljanju bazičnih struktura metodskih postavki koje osiguravaju precizne smjernice za rad skijaškim stručnjacima različitog obrazovanja. Ovo istraživanje čini dobar temelj budućim istraživanjima u kojima bi bilo poželjno uključiti skijaške stručnjake diljem svijeta, te dodatno precizirati i izvršiti evaluaciju ekspertnog modela za poduku osnovnog zavoja.

struments occurred, whose practical application should enable better quality selection, and the choice of training modalities and training exercises in the process of education of alpine skiers of different age and level of skiing knowledge.

DISCUSSION

The general review of the obtained results of the conducted research, with the aim of forming the hierarchical classification of the expert model of methodological exercises for basic turn teaching, and the examination of statistical difference significance between three groups of skiing experts of different levels of education in their evaluation, leads towards the conclusion that the obtained knowledge generally enables relatively higher quality of alpine skiers teaching process planning.

In spite of the different degree of skiing education that examinees that formed the hierarchical classification of the expert model of methodological exercises for basic turn teaching had, the difference between them was not determined. Based on this, it can be concluded that they made a homogeneous group that recognised the importance and the contribution of the individual exercise in the alpine skiers teaching methodics. Since there are no papers of similar topic, this research is especially valuable, in the sense that it sets the basic structures of methodological settings that secure the precise guidelines for the work of skiing experts of different education. This research is a good basis for the future research in which could include skiing experts worldwide, and additionally determine and perform the evaluation of basic turn teaching expert model.

LITERATURA / REFERENCES

- Anderson D. (2007). *Ski school*. United Kingdom: New Holland Publishers.
- Feinberg, Densmore, L. (2000). *Ski faster*. Camden, ME: Ragged Mountain Press.
- Fry, J. (2006). *The story of modern skiing*. UPNE.
- Ilić, B., Ropret, R., & Ilić, M. (2010). *Virtuelno alpsko skijanje*. Beograd: Fakultet sporta i fizičke kulture. [In Serbian]
- Jurković, N., & Jurković, D. (2003). *Skijanje, tehnika, metodika i osnove treninga*. Zagreb: Graphis. [In Croatian]
- Kuna, D. (2012). Formiranje ekspertnog modela likova osnovne i napredne škole skijanja. *Proceedings Of The 3rd International Conference Contemporary Kinesiology*. Miletic Đurdica et al. (Ur.).Split : Faculty Of Kinesiology University Of Split, Croatia. 145-153. [In Croatian]
- Kuna, D. (2013). Metodički model za poduku osnovnog skijaškog zavoja. *Sport Mont*“ 37-39. Crnogorska sportska akademija. [In Croatian]
- Lešnik, B., & Žvan, M. (2010). A turn to move on – Alpine skiing – Slovenian way, Theory and methodology of alpine skiing; Szs – Združenje učiteljev in trenerjev smučanja.
- Matković, B., Ferenčak, S., & Žvan, M. (2004). *Skijajmo zajedno*. Zagreb: Europapress holding i FERBOS inženjering. [In Croatian]
- Murovec, S. (2006). *The edge. OPS-learning by extending the ski*.
- Puškarić, D. (2010). *Istina o skijanju*. Ogulin: INFOSTUDIO [In Croatian]

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PROMJENE FUNKCIONALNIH SPOSOBNOSTI ŽENA POD UTICAJEM REKREATIVNOG PLIVANJA

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Sažetak: Istraživanje je imalo za cilj utvrditi promjene funkcionalnih sposobnosti žena pod uticajem rekreativnog plivanja. Populacija iz koje je izvučen uzorak je populacija zdravih žena, hronološke starosti od 35 do 45 godina, kod kojih dominira sedentaran način života. Procjena funkcionalne sposobnosti je testirana sa sljedećim varijablama: vitalni kapacitet, frekvencija srca u miru, radni puls, sistolni arterijski krvni pritisak, dijastolni krvni pritisak i relativna potrošnja kiseonika. Za sve rezultate izračunati su osnovni parametri deskriptivne statistike, a za utvrđivanje razlike između inicijalnog i finalnog mjerjenja primjenjen je t-test. Rezultati istraživanja su pokazali da je nakon tromjesečne primjene rekreativnog plivanja došlo do statistički značajnih promjena vitalnog kapaciteteta ($p = 0,000$), frekvencije srca u miru ($p = 0,000$) i relativne potrošnje kiseonika ($p = 0,000$). Istraživanjem je ustanovaljeno da program rekreativnog plivanja kod sedentarnih žena srednjih godina može efikasno djelovati na promjene funkcionalnih sposobnosti.

Ključne riječi: rekreacija, rekreativno plivanje, funkcionalne sposobnosti.

Uvod

Rekreativno plivanje je fizička aktivnost koja zbog svojih karakteristika može u mnogome odgovoriti potrebama savremene žene. Kao fizička aktivnost, plivanje može poboljšati zdravlje, fizičku kondiciju i kvalitet života (Saavedra i sar. 2007, Colado i sar. 2009, Fletcher i sar. 1996, Cox i sar. 2008, Nualnim i sar. 2012). Trening plivanja aktivira sve mišiće tijela, poboljšava funkciju svih sistema, kao i mišićnu i kardiovaskularnu izdržljivost (Ferretti, et all. 2014). Programi plivanja su aerobne aktivnosti koje omogućuju zdravstvene prednosti u opštoj populaciji (Schmid et al. 2007). Vježbanje u vodi

CHANGES IN FUNCTIONAL ABILITIES OF WOMEN UNDER THE INFLUENCE OF RECREATIONAL SWIMMING

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Abstract: The research was aimed at determining the changes in functional abilities of women under the influence of recreational swimming. The sampled population consisted of healthy women, aged 35 to 45, chronologically, with a dominant sedentary lifestyle. The assessment of functional ability was tested using the following variables: vital capacity, heart rate at rest, working heart rate, systolic blood pressure, diastolic blood pressure and relative oxygen consumption. Basic parameters of descriptive statistics were calculated for all the results, whereas the T-test was applied to determine the difference between the initial and final measurement. The results of the research showed that there were statistically significant changes of vital capacity after three months of recreational swimming ($p = 0.000$), heart rate at rest ($p = 0.000$) and relative oxygen consumption ($p = 0.000$). The research found that the programme of recreational swimming with sedentary middle-aged women can act effectively to change functional abilities.

Keywords: recreation, recreational swimming, functional ability.

INTRODUCTION

Recreational swimming is a physical activity that can greatly meet the needs of modern women due to its characteristics. As a physical activity, swimming can improve health, physical fitness and the quality of life (Saavedra et al. 2007, Colado et al. 2009, Fletcher et al. 1996, Cox et al. 2008, Nualnim et al. 2012). A swimming training activates all body muscles, improves the function of each system, including the muscle and cardiovascular endurance (Ferretti, et all. 2014). Swimming programmes are aerobic activities that provide health benefits to general population (Schmid et al. 2007). Exercising in water has advantages in com-

ima prednost u odnosu na druge oblike aerobnih aktivnosti za ljude koji imaju artritis, dijabetes, teškoće u razvoju, odnosno višak težine (Lin, Davey, i Cochrane, 2004). Aerobik u vodi povećava aerobni kapacitet za 24%, izdržljivost za 24%, i toleranciju vježbe za 26% Minor, Hewett, Webel, Anderson, i Kay, 1989). Programi vježbi u vodi kada je glava iznad površine vode, mogu značajno poboljšati antropometrijske mjere, sastav tijela i uticati na fiziološke promjene kod zdravih žena srednjih godina (Barbosa i sar., 2009). Povećanje kardiovaskularne izdržljivosti doprinosi većoj potrošnji kalorija, a njihova potrošnja je veća kada se povećava trajanje i intenzitet vježbe. Plivanje jača žensko srce, pomaže u regulisanju nivoa krvnog pritiska i holesterola, a smanjuje rizik od moždanog udara i bolesti srca. Plivanje štiti zglobove od pokreta visokog intenziteta, kao što je lupanje i poskakivanje, koji su zajednički za vrijeme trčanja ili drugih kopnenih aktivnosti. Plivanje je dobar izbor vježbanja za žene s osteoporozom, bolešću koja čini kosti krhke i slabima. Vježbanje u vodi omogućava tijelu 12 do 14 posto više otpora nego prilikom vježbanja na kopnu, što iziskuje puno veću potrošnju kalorija. To se dešava zbog toga što je voda skoro 800 puta gušća od vazduha, i svaki udarac, guranje, i sila je poput mini treninga otpora za cijelo tijelo, naročito oko središnjeg dijela, bokova, ruku, ramena i zadnjice. Voda u osnovi neutralizuje gravitaciju, pa je tijelo uronjeno u vodu gotovo bez težine i rizika ozljede, što se ne može isto reći za trčanje ili trening snage. Sa medicinskog, a posebno ortopedskog stanovišta, plivanje se ubraja u najpogodnije oblike tjelesnog vježbanja. Nema praktično dobnog ograničenja, plivati može dijete od rođenja, a starija osoba do kraja života. Cirkulacijski sistem je pri plivanju rasterećen, jer se cirkulacijska petlja velikog krvotoka nalazi u vodoravnem položaju, a hidrostatski pritisak na površini tijela djeluje povoljno na venski krvotok. Plivanje je naročito povoljno za gojazne osobe, koje teže nalaze odgovarajući oblik rekreativne aktivnosti, jer se u vodi "gubi" masa tijela. Život savremene žene i njena višestruka uloga, dovodi do hroničnog zamora, smanjenja energetskog potencijala (mentalnog i fizičkog) i pojave mnogih bolesti kao što su anksioznost, kardiorespiratori poremećaji i mentalni poremećaji. Zbog toga postoji jaka potreba za bijeg iz svakodnevnog života koristeći kretnu rekreaciju u slobodnom vremenu, a jedna od takvih aktivnosti je plivanje (Berger, 1983). Fizičke prednosti rekreativnog plivanja u cjelini su fizička kondicija, poboljšanje kardiorespiratornog i kardiopulmonalnog sistema i mišićna izdržljivost tijela. Pored toga kod žena te prednosti su u smanjenju tjelesne težine i rizik od srčanih bolesti, sma-

parison to other forms of aerobic activities for people who suffer from arthritis, diabetes, disability, i.e. excess weight (Lin, Davey and Cochrane, 2004). Water aerobics increase aerobic capacity by 24%, endurance by 24% and exercise tolerance by 26% (Minor, Hewett, Webel, Anderson and Kay, 1989). Programmes of exercising in water when you keep your head above the water surface can significantly improve anthropometric measures, body composition and influence physiological changes of healthy middle-aged women (Barbosa et al. 2009). Increasing cardiovascular endurance contributes to the increased calorie consumption due to the increased duration and intensity of training. Swimming strengthens women's heart, helps regulate the level of blood pressure and cholesterol and reduces the risk of a stroke and heart diseases. Swimming protects the joints from high intensity movements, such as pounding and bouncing, which are common during running or other land activities. Swimming is a good choice of exercise for women with osteoporosis, a disease that makes bones fragile and weak. Exercising in water provides the body with 12 to 14 percent more resistance than exercising on land, which requires a significantly greater consumption of calories. That happens due to the fact that water is almost 800 times denser than air and each stroke, push or force is like a mini workout of resistance for the whole body, especially the central parts, hips, arms, shoulders and buttocks. Water basically neutralises gravitation, therefore the body immersed in water has almost no weight or the risk of injury, which you cannot say for running or workout of strength. From a medical, and particularly from the orthopaedic point of view, swimming is listed as one of the most convenient forms of physical exercise. Practically, there is no age limit; a child can swim from its birth, as well as elderly people until the end of their life. Circulation system is relieved in swimming, because the circulation loop of the large blood flow is in a horizontal position, whereas the hydrostatic pressure at the surface of the body acts favourably to the venous circulation. Swimming is particularly convenient for obese people, who have trouble finding appropriate forms of recreational activities, because body mass "disappears" in water. The life of a modern woman and her multiple roles lead to a chronic fatigue, decreased energy potential (mental and physical) and the occurrence of many diseases such as anxiety, cardiorespiratory disorders, mental disorders etc. Therefore, there is a strong need to escape from the everyday life using movable recreation in free time, and one such activity is swimming (Berger, 1983). Physical benefits of recreational swimming are purely consisted in physical fitness, improved cardiorespiratory and cardiopulmonary systems and muscular endurance of the body. In addition, for women these benefits

njenje negativnih psiholoških faktora i simptoma menopauze, liječenje celulita, poboljšanje cirkulacije, zaštite žena od rastuće bolesti raka. Cilj istraživanja je da se utvrdi da li postoje razlike u funkcionalnim sposobnostima sedentarnih zdravih žena srednjih godina prije i nakon polaženja programa rekreativnog plivanja.

METOD RADA

Uzorak ispitanika

Populacija iz koje je izvučen namjerni uzorak za istraživanje, sačinjavale su zdrave žene sa prostora grada Banja Luka, starosti od 35 do 45 godina, kod kojih u pogledu djela životnih navika dominira sedentaran način života. Sve ispitanice (38) koje su bile obuhvaćene istraživanjem, redovno su pohađale program rekreativnog plivanja koji je realizovan na Gradskom olimpijskom bazenu u Banjoj Luci.

Uzorak varijabli

Procjena funkcionalnih sposobnosti mjerena je sa sljedećim varijablama: vitalni kapacitet (FVITKP), frekvencija srca u miru (FFSRCM), radni puls (FFSRCR), sistolni arterijski krvni pritisak (FTASI), dijastolni arterijski krvni pritisak (FTADI) i relativna potrošnja kiseonika (FRO_2max). Radni puls se mjerio odmah nakon realizacije testa hodanja UKK2km palpatorno u predjelu

include weight loss and reduced heart disease risk, decrease of negative factors and symptoms of menopause, treatment of cellulite, improved circulation, protection of women from the growing cancer risk. The aim of this research is to establish whether there are differences in functional abilities of healthy sedentary middle-aged women before and after the programme of recreational swimming.

METHOD OF WORK

The sample

The population from which the sample was taken for this research can be defined as the population of healthy women from the area of the city of Banja Luka, aged 35 to 45, with a dominant sedentary lifestyle. All the examinees (38) who were included in the experiment, regularly attended the programme of recreational swimming which was implemented at the city's Olympic pool in Banja Luka.

The sample of variables

The evaluation of functional abilities was measured with the following variables: vital capacity (FVITKP), heart rate at rest (FFSRCM), working heart rate (FFSRCR), systolic arterial blood pressure (FTASI), diastolic arterial blood pressure (FTADI) and relative oxygen consumption (FRO_2max). Working heart rate was measured immediately after the completion of the test of walking UKK2km palpation

Tabela 1. Program plivanja / Table 1. Swimming Programme

Vježbe / Exercises	Sedmica / Week	Opterećenje / Load	Učestalost / Rate
Zagrijavanje (10 min) / Warming up (10 min)	Istezanje / Stretching		RPE 75
Glavne vježbe (40 min) / Main exercises (40 min)	1.Kraul - udarci nogama / Crawl – leg stroke 2.Disanje u pokretu / Breathing while moving 3.Plutanje horizontalno / Floating horizontally 4.Udarci sa daskom za plivanje / Movements with swimming board 5. Kraul ruke / Crawl hands 6.Kombinacija slobodnog stila / Free style combination 7.Ledno udarci nogama / Leg movements in backstroke 8.Kraul plivanje / Crawl swimming 9.Ledno ruke / Backstroke of arms 10.Ledna kombinacija / Backstroke combination 11.Ledno plivanje / Backstroke swimming 12.Prsno-udarci nogama / Breaststroke swimming - legs 13.Prsno ruke / Breaststroke -arms 14.Prsno plivanje / Breaststroke swimming 15.Prsno kombinacija / Breaststroke combination	1- 4 sedmica / week 5-8 sedmica / week 9-12 sedmica / week	55-65% HRR (RPE 8-10) 65-75% HRR (RPE 10-12) 75–85% HRR (RPE 12-14) 3 puta/sedmično / times/week
Hlađenje (10 min) / Cooling (10 min)	Istezanje / Stretching		RPE 75

karotidne arterije tako što su brojani otkucaji srca u 10 sekundi pa se dobijena vrijednost množila sa šest. Sistolni i dijastolni arterijski krvni pritisak mjerio se apatom sa manžetnom marke "Teleoptik". Izračunavanje fitnes indeksa i određivanje relativne potrošnje kiseonika (RVO_2max - mL/kg/min) realizovalo se indirektnom metodom pomoću formula koje su izvedene iz UKK2km testa hodanja (Oja i Tuxworth, 1995).

Program plivanja

Program rekreativnog plivanja je trajao tri mjeseca, tj. 12 sedmica. Treninzi su se održavali tri puta sedmično u večernjim terminima, svaki trening je trajao 60 minuta. Vježbe zagrijavanja i hlađenja trajale su po 10 minuta, a glavne vježbe su trajale 40 minuta. Detaljan program plivanja prikazan je u tabeli 1.

Metode obrade podataka

Za svaku varijablu izračunati su osnovni parametri deskriptivne statistike: minimalni rezultat (Min), maksimalni rezultat (Max), aritmetička sredina (AS), standarna devijacija (SD), - asimetričnost distribucije rezultata (Skew), spljoštenost distribucije rezultata (Kurt.). Za utvrđivanje razlika između inicijalnog i finalnog mjerenja primjenjen je t-test (Malacko i Popović, 2001). Značajnost razlika utvrđena je na nivou $p<0,05$.

REZULTATI

Rezultati deskriptivne analize obuhvatili su osnovne parametre identifikovanih funkcionalnih sposobnosti na inicijalnom i finalnom mjerenu (Tabela 2). U kontekstu inicijalnog mjerjenja uočava se da vrijednosti centralnih i disperzionih parametara varijabli za procjenu funkcionalnih sposobnosti pokazuju normalnu raspodjelu rezultata. Uvidom u dobijene vrijednosti rezultata funkcionalnih sposobnosti na finalnom mjerenu može se konstatovati da nema značajnih odstupanja od normalne distribucije, s obzirom na to da vrijednosti koeficijenata zakrivljenosti (Skjunis) ne prelaze 1,00, izuzev kod varijable *Vitalni kapacitet (FVITKP)* (-1,714), koja značajno odstupa od normalne distribucije. Vrijednosti koeficijenta zaobljenosti (Kurtosis) kreću se ispod normalne vrijednosti distribucije 2,75, što čini distribuciju platikurtičnom ili raspšinutom, izuzev kod varijable *Vitalni kapacitet (FVITKP)* (4,690), što ukazuje na povećanu koncentraciju rezultata oko aritmetičke sredine.

measurement in the area of carotid artery by measuring heart beats in 10 seconds multiplying the resulting value by six. Systolic and diastolic arterial blood pressures were measured by a device with a "Teleoptik" brand cuff. Calculation of fitness index and the determination of relative oxygen consumption (RVO_2max - mL/kg/min) were achieved through an indirect method using formulas derived from UKK2km test of walking (Oja & Tuxworth, 1995).

Swimming programme

The programme of recreational swimming lasted three months, i.e. 12 weeks. Trainings were held three times a week in the evening, each training session lasted for 60 minutes. Warming and cooling exercises lasted about 10 minutes, whilst main exercises lasted for 40 minutes. A detailed programme of swimming is shown in Table 1 given below.

Methods of data processing

Basic parameters of descriptive statistics were calculated for each variable: minimum score (Min), maximum score (Max), arithmetic mean (AS), standard deviation (SD), - asymmetry of result distribution (Skew), flatness of result distribution (Kurt.). In order to determine the difference between the initial and final measurement, the T-test was applied (Malacko and Popović, 2001). The significance of the conclusion was determined at the level of $p<0,05$.

RESULTS

The results of the descriptive analysis included the basic parameters of the identified functional abilities at the initial and final measurement (Table 1). In the context of the initial measurement, it can be noted that the values of central and dispersion variable parameters for the assessment of functional abilities showed normal distribution of results. After examining the values of the results obtained for functional abilities at the final measurement, it can be concluded that there are no significant deviations from the normal distribution, given that the values of the coefficient of curvature (Skjunis) do not exceed 1,00, except for the variable of *Vital capacity (FVITKP)* (-1,714), which significantly differs from the normal distribution. The values of the coefficient kurtosis (Kurtosis) are below the normal value of distribution 2,75, which makes the distribution platykurtic or fuzzy, except for the *Vital capacity* variable (*FVITKP*) (4,690), indicating an increased concentration of results around the arithmetic mean.

Tabela 2. Deskriptivni statistički parametri funkcionalnih varijabli na inicijalnom i finalnom mjerenuju /
Table 2. Descriptive statistical parameters of functional variables on initial and final measuring

	Variable	n	Min.	Max.	AS	SD	Sk.	Kt.
INITIAL	FVITKP	38	2100	3700	3040.79	320.442	-.581	.923
	FFSRCM	38	62	96	83.16	8.089	-.928	.426
	FFSRCR	38	119	186	159.34	18.594	-.625	.317
	FTASI	38	104	164	124.66	14.880	.778	.167
	FTADI	38	60	86	74.16	6.792	.038	-.524
	FRVO ₂ maks. ml/kg/min	38	15.9	49.3	32.532	7.9510	-.082	.120
FINAL	FVITKP	38	2200.0	4000.0	3484.211	345.2585	-.714	4.690
	FFSRCM	38	64.0	84.0	75.789	6.2349	-.626	-.627
	FFSRCR	38	136.0	178.0	159.842	10.3598	-.340	-.477
	FTASI	38	114.0	138.0	127.053	5.4572	-.110	-.409
	FTADI	38	68.0	92.0	75.211	5.1473	.836	1.683
	FRVO ₂ maks. ml/kg/min	38	22.2	53.1	37.782	7.2218	-.085	.172

Legenda: **n** - Broj ispitanika; **Min** - Minimum; **Max** - Maksimum; **AS** - Aritmetička sredina; **SD** – Standardna devijacija; **Skew** - Asimetričnost distribucije rezultata; **Kurt.** - Spljoštenost distribucije rezultata; **FVITKP** – Vitalni kapacitet; **FFSRCM** – Frekvencija srca u miru; **FFSRCR** – Radni puls **FTASI** – Sistolni krvni pritisak; **FTADI** – Dijastolni krvni pritisak; **FRVO₂maks. ml/kg/min** – Relativna potrošnja kiseonika; **Initial** - Inicijalno, **Final** - Finalno. /

Legend: **n** – Number of respondents; **Min** - Minimum; **Max** - Maximum; **AS** - Arithmetic mean; **SD** – Standard deviation; **Skew** – Result distribution asymmetry; **Kurt.** – Result distribution flatness; **FVITKP** – Vital capacity; **FFSRCM** – Heart frequency at rest; **FFSRCR** – Working pulse; **FTASI** – Systolic blood pressure; **FTADI** – Diastolic heart pressure; **FRVO₂maks.** – Relative Oxygen Consumption; **Initial**- **Final**

Rezultatima t-testa kojim su utvrđivane promjene između inicijalnog i finalnog mjerjenja (Tabela 3) bili su opsevirani parametri: aritmetičke sredine razlike između inicijalnih i finalnih mjerjenja (AS inicijalnog i finalnog mjerjenja), standardna devijacija između inicijalnog i finalnog mjerjenja (SD), Pearsonov koeficijent korelacijske (r), vrijednost t-testa (t), kao i vjerovatnoća greške pri odbacivanju hipoteze (p). Na osnovu testiranih varijabli za procjenu funkcionalnih sposobnosti, vidi se da između inicijalnog i finalnog mjerjenja postoji statistički značajna razlika kod varijabli *Vitalni kapacitet* (*FVITKP*, $p = 0,000$), *Frekvencija srca u miru* (*FFSRCM*, $p = 0,000$) i *Relativna potrošnja kiseonika* (*FRVO₂max*, $p = 0,000$), u smjeru poželjnijih rezultata u finalnom mjerjenju. Kod ostalih varijabli uočene razlike nisu statistički značajne. Kod sve tri navedene varijable uočene razlike su rezultati finalnog mjerjenja.

The results of the T-test, which was used to determine the changes between the initial and final measurement (Table 3) consisted of the observed parameters: arithmetic mean of the initial and final measurements (AS initial and final measurements), standard deviation between the initial and final measurements (SD), Pearson coefficient of correlation (r), T-test value (t), as well as the probability of errors in the rejection of this hypothesis (p). Based on the tested variables for assessment of functional abilities, it can be seen that between the initial and final measurement there is a statistically significant difference when it comes to the variables of *Vital capacity* (*FVITKP*, $p = 0,000$), *Heart rate at rest* (*FFSRCM*, $p = 0,000$) and *Relative oxygen consumption* (*FRVO₂max*, $p = 0,000$), while the noted differences when it comes to other variables were not statistically important. The differences noted with regards to all three given variables were a result of the final measurement.

Tabela 3. *T-test razlika između inicijalnog i finalnog mjerjenja u varijablama za procjenu funkcionalnih sposobnosti /*
Table 3. *T-test between the initial and final measuring in variables for the evaluation of functional abilities*

Varijable		AS	SD	r	t	p
FVITKP	Initial	3040.789	320.442	0.845	-14.634	0.000
	Final	3484.211	345.258			
FFSRCM	Initial	83.158	8.089	0.702	7.843	0.000
	Final	75.789	6.235			
FFSRCR	Initial	159.342	18.594	0.165	-0.156	0.877
	Final	159.842	10.360			
FTASI	Initial	124.658	14.880	0.514	-1.140	0.262
	Final	127.053	5.457			
FTADI .	Initial	74.158	6.792	0.362	-0.944	0.352
	Final	75.211	5.147			
FRVO ₂ ,maks ml/kg/min	Initial	32.532	7.951	0.907	-9.642	0.000
	Final	37.782	7.222			

Legenda: *M - Aritmetička sredina; SD - Standardna devijacija; SE - Standardna greška; r - Pirsonov koeficijent korelacije; t - vrijednost Studentova t-testa; p - Vjerovatnoća; FVITKP – Vitalni kapacitet inicijalni – finalni; FFSRCM – Puls u mirovanju inicijalni – finalni; FFSRCR – Radni puls inicijalni – finalni; FTASI – Sistolni pritisak inicijalni – finalni; FTADI – Dijastolni pritisak inicijalni – finalni; FRVO₂maks. ml/kg/min – Relativna potrošnja kiseonika inicijalna – finalna /*

Legend: *M – Arithmetic mean; SD – Standard deviation; SE – Standard error; r – Pearson correlation coefficient; t – value of the Student's t-test; p - Probability; FVITKP – Vital capacity – initial-final; FFSRCM – Pulse at rest initial – final; FFSRCR – Working pulse initial-final; FTASI – Systolic pressure initial - final; FTADI – Diastolic pressure initial - final; FRVO₂maks. – Relative oxygen consumption initial – final.*

DISKUSIJA

Rekreativno plivanje predstavlja aktivnost koja se bez rizika može upotrijebiti, kako za poboljšanje funkcionalnih sposobnosti, tako i sveukupnog zdravlja kod najšire populacije rekreativnih vežbača. Tretirane varijable su funkcionalno povezane i predstavljaju indikator sposobnosti kardiovaskularnog, respiratornog i drugih organskih sistema (Costil, 1992). Za dobre funkcionalne sposobnosti potreban je odgovarajući nivo sposobnosti, a one se mogu ostvariti redovnim i odgovarajućim fizičkim aktivnostima. Green (1989) iznosi podatak da je aerobik u vodi idealan modalitet za povoljne zdravstvene promjene. Analizirajući rezultate istraživanja (Tabela 3) vidimo da je najbolji rezultat (poboljšanje za 443,422 ml) ostvaren kod varijable Vitalni kapacitet (FVITKP, pre test 3040,789, post test 3484,211, p = 0,000). Poboljšanja ove sposobnosti se ogleda u specifičnim vježbama kada je glava u vodi prilikom horizontalnog kretanja tijela kroz vodu, te intervalne vježbe promjenljivog intenziteta. Naime, disanje izvan vode omogućuje površinsko (grudno) disanje, za razliku od aktivnosti plivanje gdje je glava u vodi i omogućuje dublje (dijafragmalno) disanje kad udah ili izdah duže traju, ili zadržavamo dah, što dodatno pospješuje rad dišnih i ostalih organa. (Khosravi i saradnici 2013) navode da trening izdržljivosti, u kombinaciji sa treningom otpora, ima veći efekat na vitalni kapacitet.

DISCUSSION

Recreational swimming is an activity that can be used without risks in order to improve functional abilities, as well as the overall health of the broad population of recreational gymnasts. Treated variables are functionally interconnected and are an indicator of the ability of cardiovascular, respiratory and other body systems (Costil, 1992). An appropriate level of skills is necessary for good functional abilities, which can be achieved through regular and adequate physical activity. Green (1989) pointed out the data that water aerobics are an ideal modality for favourable health changes. The analysis of research results (Table 3) shows that the best results (the improvement by 443,422 ml) were achieved in the Vital capacity variable (FVITKP, pre test 3040,789, post test 3484,211, p = 0,000). Improvements of this ability are reflected in specific exercises when the head is in the water during horizontal body movement through the water, as well as in the interval exercise of a variable intensity. Namely, breathing outside the water enables surface (thorax) breathing, as opposed to swimming activities where the head is in the water allowing a deeper (diaphragmatic) breathing when an inhale or an exhale last longer, or in case of holding a breath, which further improves the functioning of respiratory and other organs. (Khosravi et al. 2013) suggest that endurance training, combined with resistance training, has

Potrošnja kiseonika, tj. njena relativna vrijednost (Tabela 3, $\text{FRVO}_2\text{max.}$ - ml/kg/min) je takođe poboljšana za 5,250 ml/kg/min (pre test 32,532, post test 37,782; $p = 0,000$). Plivanje je aktivnost kojom se mogu povećati aerobne sposobnosti, a potrošnja kiseonika je osnovni indikator aerobne sposobnosti. Poboljšanje ove sposobnosti, omogućio je kontinuirani rad u aerobnoj zoni, koji se intenzitetom opterećenja i dužinom dionice progresivno povećavao svaki naredni mjesec. Slično našem istraživanju, autori (Martin i saradnici, 1987) su testirali intenzivni program plivanja na kardiovaskularnu adaptaciju žena i muškaraca srednje dobi. Program je trajao 12 nedjelja, 6 puta sedmično se plivalo, a tri puta sedmično se radilo sa utezima. Svaki trening je trajao 60 minuta. Prve dvije sedmice ispitanici su plivali 30 do 45 minuta po treningu. Zadnje dvije sedmice ispitanici su u prosjeku plivali 2 km po treningu u režimu kontinuiranog i intervalnog rada. Od ukupne preplivane udaljenosti pojedinačnog treninga, oko 25% se odnosio na rad donjih ekstremiteta. Kružni trening se izvodio sa 15 pojedinačnih vježbi koje su uključivale gornje i donje ekstremitete, a svaka vježba se ponavljala 10 do 15 puta. Top of Form

Rezultati plivanja su pokazali da je nakon tretmana plivanja VO_2max poboljšan za 16% ($p < 0,001$). Povećana potrošnja kiseonika ($\text{VO}_2 \text{ max}$) je bila povezana sa manjim brojem otkucaja srca u mirovanju. Frekvencija srca je mjera kojom se može precizno kontrolisati i dozirati opterećenje u radu. Naši rezultati finalnog mjerenja pokazuju da je puls u mirovanju smanjen za 7,369 otkucaja u minuti (pre test 83,158, post test 75,789; $p = 0,000$). Pozitivne promjene ove sposobnosti (testa), omogućio je kontrolisani rad sa vježbama kontinuiteta i intervalnog treninga dionica plivanja u aerobnoj zoni rada. Naime, intenzitet kontinuiranog i intervalnog rekreativnog plivanja, odnosno dionice plivanja, progresivno su se povećavale iz mjeseca u mjesec. Napredak/trenutno stanje je praćeno mjeranjem pulsa poslije svake aktivnosti/dionice, čime se kontrolisao intenzitet poslije rada i isti planirao za narednu aktivnost. Naši rezultati se mogu uporediti sa rezultatima Mohr-a i saradnika (2014) koji su istraživali uticaj rekreativnog plivanja na blagu hipertenziju kod sedentarnih žena srednjih godina. Uzorak od 67 žena, podijeljenih u tri grupe (visoki i umjereni intenzitet i kontrolna) su bile pod tretmanom 15 sedmica. Grupa koja je plivala visokim intenzitetom (3 puta sedmično, 6-10 intervala u 30 minuta sa pauzom od 2 minuta između) je smanjila puls u mirovanju za 5 ± 1 min ($p < 0,05$) i masno tkivo za $1,1 \pm 0,2$ kg ($p < 0,05$). Druga grupa, koja je plivala u kontinuitetu umjerenim intenzitetom (3 x sedmično) je takođe smanjila puls u

a greater effect on vital capacities. Oxygen consumption i.e. its relative value (Table 3, $\text{FRVO}_2\text{max.}$ - ml/kg/min) is also improved by 5.250 ml/kg/min (pre test 32.532, post test 37.782; $p = 0.000$). Swimming is an activity which can increase aerobic capacity, whilst oxygen consumption is the main indicator of aerobic capacity. The improvement of this capacity was enabled by a continuous work in aerobic zone, which increased progressively each month by the intensity of load and the length of swimming section. Similar to our research, authors (Martin et al, 1987) tested an intensive swimming programme at cardiovascular adaptation of middle-aged women and men. The programme lasted 12 weeks, with swimming organised 6 times a week and exercises with weights were done three times a week. Each training session lasted 60 minutes. During the first two weeks, the examinees swam 30 to 45 minutes per session. The final two weeks, the examinees swam on average 2 km per session in a workout of continuous and interval regime. Out of the total distance of swimming during an individual training, around 25% focused on lower extremities. Circuit training was performed with 15 individual exercises which included upper and lower extremities, whereas each exercise was repeated 10 to 15 times. The results of swimming showed that after a swimming sessionTop of Form

the results of swimming VO_2max was improved by 16% ($p < 0.001$). The increased oxygen consumption ($\text{VO}_2 \text{ max}$) was associated with fewer heart beats at rest. Heart rate is a measure which enables a precise control and dosing of load at work. Our results of final measurement showed that the pulse at rest was reduced by 7.369 beats per minute (pre test 83.158, post test 75.789; $p = 0.000$). Positive changes of this ability (test) were enabled by a controlled work with exercises of continuity and interval training at swimming sections in aerobic work zone. Namely, the intensity of continuous and interval recreational swimming, i.e. swimming section, was progressively increased from one month to another. Progress/current state was monitored by measuring the pulse after each activity/section, thereby controlling the intensity after work and planning it for the following activity. Our results are comparable with the results of Mohr et al (2014) who studied the impact of recreational swimming at mild hypertension in sedentary middle-aged women. A sample of 67 women, divided into three groups (high and moderate intensity and control), were under the treatment for 15 weeks. The group which swam with high intensity (3 times a week, 6-10 intervals in 30 minutes with a 2-minute break in-between) reduced the pulse at rest by 5 ± 1 min ($p < 0,05$) and adipose tissue by 1.1 ± 0.2 kg ($p < 0.05$).

mirovanju za 5 ± 1 min ($p < 0,05$) i masno tkivo za $2,2 \pm 0,3$ kg ($p < 0,05$). U kontrolnoj grupi sve mjerene varijable su bile slične prije i poslije perioda intervencije. Autori zaključuju da visoki intenzitet sa prekidima plivanja je efikasna strategija obuke za poboljšanje kardiovaskularnog zdравља i fizičke performanse u sedentarnih žena sa blagom hipertenzijom. Adaptacije su slične za trening visokog i umjerenog intenziteta, iako je vidljivo manje provedenog ukupnog vremena i prijeđenih kilometara u grupi visokog intenziteta. U ovom istraživanju, rekreativni program plivanja kombinovan intervalima i kontinuitetom uticao je na efikasnu adaptaciju funkcionalnih sposobnosti neaktivnih žena srednjih godina. Rezultati istraživanja omogućuju šire sagledavanje uticaja rekreativnog plivanja kao oblik zdрављa i fitnes treninga, kao i stvaranja baze podataka o funkcionalnim sposobnostima srednjovječnih žena za ovu aktivnost.

ZAKLJUČAK

Analizirajući vrijednosti tretiranih varijabli, kao pokazatelje funkcionalnih sposobnosti nakon tromjesečnog rekreativnog plivanja, zaključujemo da su najbolji rezultati, statistički značajni, ostvareni u povećanju vitalnog kapaciteta, većoj relativnoj potrošnji kiseonika i manjoj frekvenciji srca u mirovanju. Tome su najviše doprinijeli zadaci intervalnog i kontinuiranog rada koji su se progresivno povećavali svaki naredni mjesec. Kod ostalih varijabli kao što je sistolni i dijastolni krvni pritisak, te radni puls, nije bilo statistički značajne promjene, te smatramo da je potreban duži trenažni vremenski period za veće promjene ovih varijabli. Naši rezultati su potvrdili dosadašnja slična istraživanja (Martin i sar. 1987; Khosravi i sar. 2013; Mohr i sar. 2014), pa se na osnovu toga za poboljšanje/pozitivne promjene funkcionalnih sposobnosti, program rekreativnog plivanja može preporučiti populaciji zdravih žena srednje dobi, kod kojih dominira sedentaran način života i rada.

Izjava autora. Autori pridonijeli jednako.

Konflikt interesa. Mi izjavljujemo da nemamo konflikt interesa.

The second group, which continuously worked with moderate intensity (3 x week) also reduced the pulse at rest by 5 ± 1 min ($p < 0,05$) and adipose tissue by $2,2 \pm 0,3$ kg ($p < 0,05$). In the control group, all measured variables were similar before and after the intervention period. The authors conclude that high intensity with breaks in swimming is an effective training strategy for the improvement of cardiovascular health and physical performances in sedentary women with mild hypertension. Adaptations were similar for high-intensity and moderate-intensity trainings, although evidently less overall time was spent and mileage achieved in the high-intensity group. In this research, the programme of recreational swimming, both with intervals and in continuity, influenced the effective adaptation of functional abilities of inactive middle-aged women. The results of this research provide a broader overview of the effects of recreational swimming as a form of health and fitness training, as well as a creation of a database on functional abilities of middle-aged women for this activity.

CONCLUSION

Analysing the values of variables treated, as an indicator of functional abilities after a three-month recreational swimming, we conclude that the best results, statistically significant, were achieved in the increase of vital capacities, greater relative oxygen consumption and lower heart rate at rest. This was mostly contributed by the tasks of interval and continuous work which were progressively increased each month. With regards to other variables, such as systolic and diastolic blood pressure, as well as the working heart rate, there were no statistically significant changes, therefore we believe that a longer training period is necessary for major changes of these variables. Our results confirmed previous similar studies (Martin et al. 1987; Khosravi et al. 2013; Mohr et al. 2014), therefore for the improvement/positive changes in functional abilities, the programme of recreational swimming can be recommended to the population of healthy middle-aged women, with a dominant sedentary work and life style.

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LITERATURA / REFERENCES

- Barbosa, T. M., Marinho, D. A., Reis, V. M., Silva, A. J., & Bragada, J. A. (2009). Physiological assessment of head-out aquatic exercises in healthy subjects: a qualitative review. *Journal of Sports Science and Medicine*, 179-189.
- Berger, B. G., & Owen, D. R. (1983). Mood Alteration with Swimming-Swimmers Really Do" Feel Better". *Psychosomatic medicine*, 45(5), 425-433.
- Colado, J. C., Triplett, N. T., Tella, V., Saucedo, P., & Abellán, J. (2009). Effects of aquatic resistance training on health and fitness in postmenopausal women. *European journal of applied physiology*, 106(1), 113-122.
- Cox, K. L., Burke, V., Beilin, L. J., Derbyshire, A. J., Grove, J. R., Blanksby, B. A., & Pudsey, I. B. (2008). Short and long-term adherence to swimming and walking programs in older women—the Sedentary Women Exercise Adherence Trial (SWEAT 2). *Preventive medicine*, 46(6), 511-517.
- Costill, D., Maglischo, E., & Richardson, A. (1992). Swimming: Handbook of Sports Medicine and Science Swimming. *IOC Medical Commission Publications Advisory Committee*.
- Fletcher, G. F., Balady, G., Blair, S. N., Blumenthal, J., Caspersen, C., Chaitman, B., ... & Pollock, M. L. (1996). Statement on exercise: Benefits and recommendations for physical activity programs for all Americans a statement for health professionals by the committee on exercise and cardiac rehabilitation of the council on clinical cardiology, American Heart Association. *Circulation*, 94(4), 857-862.
- Ferretti, E., De Angelis, S., Donati, G., & Torre, M. (2014). Fatal and non-fatal unintentional drownings in swimming pools in Italy: Epidemiological data derived from the public press in 2008–2012. *Microchemical journal*, 113, 64-68.
- Green, J. S. (1989). Effects of a Water Aerobics Program on the Blood Pressure, Percentage of Body Fat, Weight, and Resting Pulse Rate of Senior Citizens. *Journal of Applied Gerontology*, 8(1), 132-138.
- Khosravi, M., Tayebi, S. M., & Safari, H. (2013). Single and concurrent effects of endurance and resistance training on pulmonary function. *Iranian journal of basic medical sciences*, 16(4), 628.
- Lin, S. Y., Davey, R. C., & Cochrane, T. (2004). Community rehabilitation for older adults with osteoarthritis of the lower limb: a controlled clinical trial. *Clinical Rehabilitation*, 18(1), 92-101.
- Malacko, J., & Popović, D. (2001). Methodology of kinesiological and anthropological research. *The third edition. Leposavić: Faculty of Physical Education, University of Priština*.
- Martin, W. H., Montgomery, J. A. M. E. S., Snell, P. G., Corbett, J. R., Sokolov, J. J., Buckey, J. C., ... & Blomqvist, C. G. (1987). Cardiovascular adaptations to intense swim training in sedentary middle-aged men and women. *Circulation*, 75(2), 323-330.
- Mohr, M., Nordsborg, N. B., Lindenskov, A., Steinholtz, H., Nielsen, H. P., Mortensen, J., ... & Krstrup, P. (2014). High-intensity intermittent swimming improves cardiovascular health status for women with mild hypertension. *BioMed research international*, 2014.
- Mikalački, M. (2005). Sports Recreation. Novi Sad: Faculty of Physical Education. [In Serbian]
- Minor, M. A., Weibel, R. R., Kay, D. R., Hewett, J. E., & Anderson, S. K. (1989). Efficacy of physical conditioning exercise in patients with rheumatoid arthritis and osteoarthritis. *Arthritis & Rheumatism*, 32(11), 1396-1405.
- Nualnim, N., Parkhurst, K., Dhindsa, M., Tarumi, T., Vavrek, J., & Tanaka, H. (2012). Effects of swimming training on blood pressure and vascular function in adults > 50 years of age. *The American journal of cardiology*, 109(7), 1005-1010.
- Oja, P., & Tuxworth, B. (Eds.). (1995). *Eurofit for adults: Assessment of health-related fitness*. Council of Europe.
- Saavedra, J. M., De La Cruz, E., Escalante, Y., & Rodríguez, F. A. (2007). Influence of a medium-impact aquaerobic program on health-related quality of life and fitness level in healthy adult females. *Journal of Sports Medicine and Physical Fitness*, 47(4), 468.
- Schmid, J. P., Noveanu, M., Morger, C., Gaillet, R., Capoferri, M., Anderegg, M., & Saner, H. (2007). Influence of water immersion, water gymnastics and swimming on cardiac output in patients with heart failure. *Heart*, 93(6), 722-727.

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RAZLIKE U ZDRAVSTVENIM POKAZATELJIMA KOD NOGOMETĀŠA MLAĐIH I STARIJIH OD 30 GODINA

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Sažetak: Brojne studije pokazuju da širi opseg antropoloških karakteristika i pokazatelja zdravlja, bitno utječe na uspjeh u nogometu. Stalno praćenje ovih pokazatelja pruža trenerima podatke korisne za planiranje trenažnog procesa, prilagođenog konkretnim sportašima. Ova studija istražuje osnovne morfološke, fiziološke i zdravstvene (MFZ) pokazatelje odraslih nogometāša raznih razina sportske izvrsnosti. Cilj ove studije je utvrđivanje razlika u MFZ pokazateljima, kao i njihovu povezanost, u odnosu na dobnu skupinu sportaša. Utvrdit će se i različiti profili nogometāša, u odnosu na odabранe MFZ varijable. Ispitan je uzorak od 813 muških nogometāša, 362 u dobroj skupini 17-30 godina ($M \pm SD 21,48 \pm 3,51$) i 451 starijih od 30 godina ($43,84 \pm 9,17$), iz zagrebačkih nogometnih klubova, koji su pristupili liječničkom pregledu na Poliklinici za medicinu rada i sporta. Pronađeno je nekoliko statistički značajnih razlika u MFZ karakteristikama između dvije dobne skupine, uglavnom u smjeru poželjnijih obilježja u mlađoj dobroj skupini. Rezultati pružaju informacije važne za planiranje treninga, ali i za zdravstvenu preventivu.

Ključne riječi: morfologija, fiziologija, prevencija, profili

Uvod

Prethodne studije su pokazale da sportaši s najboljim izvedbama u različitim sportovima imaju karakteristična antropološka obilježja, ovisno o zahtjevima pojedine vrste sporta i razine sportske izvrsnosti (Milanović, 1997). Stalno praćenje tih relevantnih svojstava, zajedno sa zdravstvenim stanjem sportaša, pruža vrijedne podatke za stvaranje odgovarajućeg trenažnog programa za određeni sport. Morfološke karakteristike i funkcionalne sposobnosti pokazale su se kao važni elementi u ukupnom antropološkom statusu sportaša. Međutim, još uvjek postoji ograničeni podaci o razlikama u tim značajkama u hrvatskim nogometnim klubovima, posebno u nižim stupnjevima natjecanja.

DIFFERENCES IN HEALTH INDICATORS IN FOOTBALL PLAYERS YOUNGER AND OLDER THAN 30 YEARS

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Abstract: Numerous studies show that wide range of anthropological characteristics and health indicators significantly affects the success in football. Therefore, constant monitoring of these indicators provides to the coaches the information useful for the planning of the training process, adjusted to concrete athletes. This study explores selected morphological, physiological characteristics and health (MPH) indicators of adult football players of various levels of sporting excellence. The aim of the study was to determine the differences in MPH indicators, as well as their correlation, stratified according to the age group of the athletes. The different profiles of players were identified, in relation to selected MPH indicators. A sample of 813 male players is examined, 362 in the age group 17-30 years ($M \pm SD 21.48 \pm 3.51$) and 451 aged over 30 years (43.84 ± 9.17), from Zagreb football clubs, included in medical examination at the Clinic for Occupational Health and Sport. Several differences in MPH are found between two age groups, mainly in direction more desirable features in younger age group. The results provide important information for planning training, but also for health prevention measures.

Keywords: morphology, physiology, prevention, profiles.

INTRODUCTION

Previous studies revealed that athletes with the best performance in different sports have distinctive anthropological characteristics, depending on the demands of the type of sports and the level of sports excellence (Milanović, 1997). Constant monitoring of these relevant characteristics, together with health status of the athletes, provides valuable data for the creation of adequate training program for the certain sport. Morphological characteristics and functional abilities are proven to be important elements in overall anthropological status of an athlete. However, there is still a limited data on differences in these features in Croatian football clubs, especially in lower ranks of competitions.

Vrhunski nogometari moraju prilagoditi višestrukim fizičkim zahtjevima igre, te moraju posjedovati razumno visoku razinu u svim područjima fizičke izvedbe (Reilly i sur., 2000). Antropometrijske (AN) i fiziološke (FI) karakteristike nogometara unutar važan su dio cjelovitog praćenja talentiranih mlađih igrača. Među ovim karakteristikama, neke su pod jakim genetskim utjecajima (npr. visina i maksimalni unos kisika), dok su ostale uglavnom okolinski određene i osjetljive na učinke treninga (Reilly i sur., 2000). U studiji nogometnih momčadi na kraju grčkog prvenstva, rezultati ukazuju na to da osobine FI mogu igrati važnu ulogu u izvedbi vrhunskih nogometara, pogotovo tjelesne masnoće (%), brzina trčanja, najveći okretni moment ekstenzora koljena i sposobnost vertikalnog skoka (Kalapotharakos i sur., 2006). Procjena sezonske varijacije u AN i FI varijablama u španjolskom profesionalnom nogometnom timu otkrila je da profesionalni nogometari imaju dobru kondiciju od početka do kraja španjolske lige (s visokim VO_{2max}), dok su promjene u VO_{max} ovise o početnim vrijednostima (Casajus, 2001).

Kondicijski trening (KT) smanjuje simpatičku aktivaciju i oksidativni stres. KT prigušuje srčanu simpatičku modulaciju i srčanu hipertrofiju, koja je povezana sa smanjenjem oksidativnog stresa i povećanjem biorasploživosti dušikova oksida (NO) (Bertagnolli et al., 2008). U studiji utjecaja KT na krvne lipide, krvni tlak i funkciju dimenzije šupljine lijeve klijetke, između nogometara i nesportaša, razina sistoličkog krvnog tlaka kod nogometara bila je znatno niži od kontrolne skupine ($p < .05$), dok su sistolički (LVSP) i dijastolički (LVDP) promjeri lijevog ventrikula nogometara bili značajno viši naspram kontrolne skupine (Gokhan et al., 2013). Slobodne mase kiseline u krvi povećale su se progresivno tijekom igre, djelomično kompenzirne progresivnim smanjenjem mišićnog glikogena, dok se umor također povremeno pojavljuje tijekom utakmice (Bangsbo i sur., 2006).

Među relevantnim značajkama u fizičkim zahtjevima za igrače tijekom igre, postoje velike individualne razlike, koje se odnose na FI kapacitete i taktičku ulogu u timu (Bangsbo i sur., 2006). Pozicijska uloga igrača odnosi se na njegove FI kapacitete. Vezni igrači (VI) i braniči imaju najviše maksimalne unose kisika ($> 60 \text{ ml} \times \text{kg}^{-1} \times \text{min}^{-1}$) i najbolji su u intervalnim testovima tjelovježbe. S druge strane, VI obično imaju najnižu snagu mišića (Reilly i sur., 2000). VI trče više u niskoj brzini nego braniči ili napadači, dok je udaljenost koju pretrče velikom brzinom ista u početku, kao na kraju meča (Bangsbo, 1994). Međutim, osim FI zahtjeva tijekom utakmice u vezi s ukupnom udaljenosti koju igrač pretr-

Top-level football players have to adapt to the multifactorial physical demands of the game, and must possess a reasonably high levels within all areas of physical performance (Reilly et al., 2000). Anthropometric (AN) and physiological (PH) characteristics of football players within are important part of a holistic monitoring of talented young players. Among these characteristics, some are under strong genetic influences (e.g. height and maximal oxygen intake) while the others are largely environmentally determined and susceptible to training effects (Reilly et al., 2000). In the study of football teams at the end of the Greek championship, the findings suggest that PH characteristics may play an important role for top-level football performance, especially body fat (%), running velocity, peak torque of knee extensors and vertical jump ability (Kalapotharakos et al., 2006). The evaluation of seasonal variation in AN and PH variables in a Spanish professional football team revealed that professional football players have good fitness from the beginning to the end of the Spanish League (with a high VO_{2max}), while the changes in VO_{2max} depend on the initial values (Casajus, 2001).

Exercise training (ET) decreases sympathetic activation and oxidative stress. ET attenuates cardiac sympathetic modulation and cardiac hypertrophy, which were associated with reduced oxidative stress and increased nitric oxide (NO) bioavailability (Bertagnolli et al., 2008). In the study of the effects of ET on blood lipids, blood pressure and left ventricular cavity dimensions function between football players and non-athletes, mean systolic blood pressure levels of football players were significantly lower than control group ($p < .05$). Left ventricular systolic and diastolic diameters of football players were significantly higher than control group (Gokhan et al., 2013). Blood free-fatty acids (FFAs) increase progressively during a game, partly compensating for the progressive lowering of muscle glycogen, while fatigue also occurs temporarily during matches (Bangsbo et al., 2006).

Among relevant features, there are major individual differences in the physical demands of players during a game, related to PH capacity and tactical role in the team (Bangsbo et al., 2006). Positional role of a player is related to his/her PH capacity. Midfield players (MP) and full-backs have the highest maximal oxygen intakes ($> 60 \text{ ml} \times \text{kg}^{-1} \times \text{min}^{-1}$) and perform best in intermittent exercise tests. On the other hand, MP tend to have the lowest muscle strength (Reilly et al., 2000). MP run more at low speed than defenders and forwards, while the distance covered at high run speed is the same in

či tijekom nogometne utakmice, onima i druge energetski zahtjevne aktivnosti, odnosno uklizavanje, skakanje, ubrzanje i okretanje (Bangsbo, 1994). Međutim, svi ovi FI zahtjevi nisu isti za igrače različitih dobnih skupina.

Stoga, glavni cilj ove studije bio je utvrditi razlike u MFZ pokazateljima, između dvije dobne skupine nogometāša. Drugo, u odnosu na odabrane MFZ pokazatelje, utvrdit će se različiti profili igrača, koji zahtijevaju drukčiji kinezioološki tretman (drugačiji program treninga procesa), s ciljem postizanja veće razine sportske izvrsnosti, ili diferencirane mjere prevencije zdravlja. Treće, odredit će se odnos između različitih MFZ pokazatelja, posebno za svaku dobnu skupinu igrača.

METODA

Ispitanici

Analizirani su podaci reprezentativnog uzorka od 813 nogometāša aktivno angažiranih u nogometnim klubovima različitog natjecateljskog stupnja u Gradu Zagrebu i Zagrebačkoj županiji, od toga 362 u dobroj grupi 17-30 godina ($M \pm SD$) ($21,48 \pm 3,51$) i 451 starijih od 30 godina ($43,84 \pm 9,17$). Nogometāši su pristupili liječničkom pregledu u Poliklinici za medicinu rada i sporta Zagrebačkog športskog saveza s medicinsko-biokemijskim laboratorijem u Zagrebu (PMRS) tijekom 2011. i 2012. godine, po principu uvrštavanja prvog liječničkog pregleda (u slučaju da je sportaš obavio više pregleda u navedenom razdoblju). U dobroj skupini 17-30 godina pregledana je sportska kategorija seniora, koji su svi aktivni sportaši-natjecatelji, dok su u dobroj skupini iznad 30 godina, uz populaciju seniora aktivnih natjecatelja, ispitani i nogometāši koji sudjeluju u veteranskim nogometnim natjecanjima. Dobna skupina iznad 30 godina definirana je kao jedinstven (homogen) uzorak zbog činjenice da većina ispitanih nogometāša zapravo igra u nižim stupnjevima natjecanja, u kojima su funkcionalna i ostala natjecateljska opterećenja podjednaka kao u veteranskim natjecanjima.

Varijable i postupci

Podaci su prikupljeni pregledom arhive ambulante Poliklinike za medicinu rada i sporta Zagrebačkog športskog saveza s medicinsko-biokemijskim laboratorijem (PMRS) u Zagrebu. U analizu su uključeni svi podaci prikupljeni od svih nogometāša u dobi od 17 do 30 te 30 i više godina, koji su pristupili liječničkom pregledu tijekom 2011. i 2012. godine, uvažavajući etičke principe Helsinski Deklaracije.

Prikupljeni su podaci o sljedećim obilježjima: tjelesna visina (cm), tjelesna masa (kg), indeks tjelesne mase

the beginning as in the end of a match (Bangsbo, 1994). However, except PH demands on the player during the match related with total distance run during the football match, a player is engaged in other energy demanding activities, i.e. tackling, jumping, accelerating and turning (Bangsbo, 1994). However, all these PH demands are not the equal for the players in different age groups.

Hence, the main aim of this study was to determine the differences in the MPH indicators, between two age groups of football players. Secondly, in relation to selected MPH indicators, different profiles of players will be determined, who require different kinesiological treatment (different ET program), in order to achieve higher levels of sporting excellence, or differentiated measures of health prevention. Thirdly, the relationship between different MPH indicators will be determined, separately for each age group of players.

METHODS

Subjects

The data of a representative sample of 813 male football players who are actively engaged in football clubs of different competitive level within the City of Zagreb and Zagreb County are analyzed, of which 362 in the age group 17-30 years ($M \pm SD$) (21.48 ± 3.51) and 451 old over 30 years (43.84 ± 9.17). The players have joined the medical examination at the POHS in 2011 and 2012, according to the principle of including the first medical examination (in case the athlete performed more hits in the mentioned period). In the age group 17-30 years, the sports category of seniors who are all active athletes-competitors were examined, while in the age group above 30, the population of seniors who are active competitors, as well as the participants in veteran football competitions, were examined. The age group over 30 is defined as a single (homogeneous) sample, due to the fact that the majority of players are actually playing in lower ranks of competition, in which the functional and other loadings are in fact similar as in veteran competitions.

Variables and procedures

Data are collected by reviewing medical records from Polyclinic for Occupational Health and Sports of Zagreb Sports Association with Laboratory of Medical Biochemistry in Zagreb (POHS). The analysis included all data, collected of all players aged 17 to 30 and over age of 30, who have joined the medical examination during 2011 and 2012, taking into account the ethical principles of the Declaration of Helsinki.

The data on the following characteristics are collected: body height (cm), body weight (kg), Body Mass

(ITM), vitalni kapacitet (l) pluća, fizikalni pregled pluća, elektrokardiogram (ECG), puls mirovanja (otk./min.), arterijski sistolički i dijastolički krvni tlak (mmHg), hemoglobin (g/l), hematokrit (l/l), leukociti (fl), trombociti (fl), sedimentacija eritrocita (mm/h), dob sportaša (godine), pripadnost nogometnom klubu.

Vitalni kapacitet pluća je mjerjen standardnim postupkom mjerena forsiranog izdisaja nakon maksimalnog udisaja u 3 pokušaja (uzima se u obzir najviša postignuta vrijednost vitalnog kapaciteta) na uređaju Schiller Spirovit SP 1, Schiller AG, made in Switzerland. Uredan nalaz pluća je definiran fizikalnim pregledom : inspekcijskim (prsti koš simetričan, dobro sveden, obostrano dobro respiratorno pomičan), perkutorno urednim plućnim zvukom, auskultacijski urednim šumom disanja (dominantno vezikularno, osim iznad velikih bronha i traheje gdje poprima obilježja bronhovezikularnog disanja) uz urednu frekvenciju disanja od 16-18 udisaja /min.

EKG snimanje je obavljeno standardnim pozicioniranjem elektroda pomoću 6 perifernih odvoda (3 standarna bipolarna odvoda ekstremiteta i 3 unipolarna odvoda ekstremiteta) i 6 prekordijalnih odvoda, uređajem Schiller AT-2 plus odnosno Schiller AT-102, Schiller AG, made in Switzerland. Elektrokardiografsko snimanje je moralo zadovoljiti kriterije tehnički kvalitetnog ispisa prije analize nalaza, uz jasni prikaz svih električnih potencijala (P, QRS, T), odnosno uz pravilno obilježavanje trajanja svih intervala (PQ, QRS, QT). Uredan nalaz pretpostavlja sinus ritam uz trajanje intervala u granicama fizioloških varijacija s obzirom na dob, s normalnim izgledom električnih potencijala uz urednu lijevostranu električnu os srca. Puls mirovanja (broj otkucaja u minuti) je prosječna vrijednost pulsa mjerena u ležećem položaju (tijekom snimanja ECG-a) te u sjedećem položaju (tijekom mjerena arterijskog tlaka). Uredan nalaz je u rasponu frekvencije od 60 do 100 otkucaja u minuti. Arterijski sistolički i dijastolički tlak (izmjera u mmHg) je vrijednost obavljenog mjerena u sjedećem položaju sa nadlaktičnom manšetom, uzimajući u obzir prosječnu vrijednost mjerena na obje strane. (Razlika u izmjerenum vrijednostima arterijskog tlaka normalno ne bi trebala biti veća od 20 mmHg za sistolički tlak odnosno veća od 10 mmHg za dijastolički tlak.) Mjerena arterijskog tlaka su obavljena uz pomoć elektronskog nadlaktičnog tlakomjera Omron M10 IT te Omron M6 Confort, Omron Healthcare Co., Kyoto, Japan, sa standardnim veličinama manšeta za odrasle osobe 12x26 cm, za odrasle pretile osobe 12x40 cm, te za djecu i mršave odrasle osobe 12x18 cm. Vrijednosti izmjerene arterijskog tlaka za odrasle osobe se procjenjuju prema važećim Smjernicama Europskog

Index (BMI), vital capacity (l) of the lungs, electrocardiogram (ECG), resting heart rate (beat/min.), arterial systolic and diastolic blood pressure (mmHg), haemoglobin (g/l), haematocrit (l/l), leukocytes (fl), platelets (fl), erythrocyte sedimentation rate (mm/h), athletes' age (years) and football club membership. Vital lung capacity was measured using a standard method of measuring of the forced exhalation after a maximal inhalation in 3 attempts (taking into account the highest vital capacity value achieved) on the Schiller Spirovit SP 1, Schiller AG, made in Switzerland. Lung finding was defined by physical examination (inspection - chest symmetric, symmetrical chest expansion, bilaterally respiratory well mobile, percussion - lower lung border: left level of 10th spinous process, right level of 8th spinous process. Respiratory float of lower lung limit is 1-2 cm in a deep inspiration). Comparative percussion: percussory normal pulmonary sound, relative dullness, absolute dullness, tympanism, hyperresonant lung sound and auscultatory examination of lung function - normal breathing sound or polyphonic bronchial whistles, intermittent, inspiratory rattles, crepitations, reduced respiration) and is considered unremarkable with breathing frequency of 16-18 breaths / min, with percussory sonority and ausculatory predominant vesicular breathing, except over the large bronchi and trachea where broncho-vesicular breathing is present. ECG is performed by recording with a standard positioning of the electrodes with setting 6 peripheral drains (3 standard bipolar extremity drains and 3 unipolar extremity drains) and 6 precordial drains, with the help of devices Schiller AT-2 plus or Schiller MT-102, Schiller AG, made in Switzerland. ECG recording had to meet the criteria of technical quality print before analysis of the findings, with a clear presentation of all electrical potentials (P, QRS, T) and with proper labelling of the duration of all intervals (PQ, QRS, QT). Normal finding assumes sinus rhythm with intervals within physiological variation ranges according to the age, with normal appearance of electric potentials and with normal left electrical axis of the heart. Resting heartbeat (beats per minute) is the average value of the pulse measured while subject is lying down (during recording the ECG) and in a sitting position (during measurement of the blood pressure). Normal finding is the frequency ranging from 60 to 100 beats per minute. Arterial systolic and diastolic blood pressure (mmHg in the survey) is the value obtained by measurement performed in a sitting position with the upper-arm cuff, taking into account the average of the measurements on both sides. (The difference in the measured values of blood pressure normally should not be higher than 20 mmHg for systolic pressure, or higher than 10 mm Hg for diastolic blood pressure.) Measurements of arterial blood pressure were carried out using

udruženja za hipertenziju i kardiologiju i Preporukama Hrvatskoga referalnog centra za hipertenziju centra izvrsnosti Europskog društva za hipertenziju, a za djecu i adolescente prema odgovarajućim literaturnim izvorima (Mancia et al., 2013; Vrdoljak et al., 2014; The Fourth Report on the Diagnosis, Evaluation, and Treatment of High Blood Pressure in Children and Adolescents, 2004).

Statistička analiza

Podaci su analizirani programom IBM SPSS 20.0. Sve razlike i povezanosti komentirane su na razini značajnosti od $p < 0,05$. Razlike u antropološkim i zdravstvenim pokazateljima analizirane su primjenom t-testa (u slučaju normalno distribuiranih varijabli omjernog tipa), odnosno neparametrijskim postupcima (Mann Whitney U test i Hi-kvadrat test), ukolikoneki od navedenih uvjeta nije zadovoljen. U analizi povezanosti korišteni su Pearsonov ili Spearmanov koeficijent korelacije, a pointbiserijalni koeficijent korelacije je izračunat između omjernih i binarnih varijabli. Konačno, za određivanje profila nogometāa pojedine dobne grupe korištena je K-means metoda klasteriranja.

REZULTATI I RASPRAVA

Razlike između dobnih skupina nogometāa za MFZ varijable prikazani su (tablica 1). Stariji (u dobi > 30) nogometāši su statistički značajno teži i imaju veći ITM te viši puls mirovanja, sistolički i dijastolički krvni tlak. Veća brzina sedimentiranja eritrocita može ukazivati na veću učestalost kroničnih upalnih i inflamacijskih bolesti te češće uzimanje lijekova u starijim dobnim skupinama sportaša (posebno u veteranskoj skupini). Brzina sedimentacije eritrocita ubrzava s povećanjem dobi, nakon 40-te godine života, a još više i kasnije (Osei-Bimpong i sur., 2007; Assasi i sur., 2015). Stariji su nogometāši niži i imaju manji vitalni kapacitet pluća, u usporedbi s mlađim dobnim skupinama. Dobiveni podaci su u skladu sa dostupnim literaturnim podacima (Reichert i sur., 2009; Hanson i Jones, 2015; Börjesson, 2016; Osei-Bimpong i sur., 2007; Assasi i sur., 2015). Povoljniji MFZ pokazatelji su povezani s obimom, intenzitetom i kontinuitetom fizičke aktivnosti, koja je uglavnom izraženija u mlađim odraslim kategorijama sportaša. Objasnjenje ovih rezultata može se također naći u velikoj razlici u prosječnoj dobi nogometāa u ove dvije dobne skupine. Stariji igrači su uglavnom veterani (prosječna dob 43.84 ± 9.17), dok seniori imaju prosječnu dob 21.48 ± 3.51 . Uz navedene razloge, nepovoljni morfološki pokazatelji potencijalno umanjuju i fiziološke kapacitete, nepovoljno djelujući i na zdravstvene pokazatelje. Suprotno navedenome, povećanje fizioloških kapaciteta organizma kroz adekvat-

electronic upper-arm sphygmomanometer Omron M10 IT and Omron M6 Comfort, Omron Healthcare Co., Kyoto, Japan, with the standard sizes of the cuffs for adults 12x26 cm, for obese adults 12x40 cm, and for children and thin adults 12x18 cm. The values of the measured blood pressure for adults is estimated according to the current guidelines of the European Society for Hypertension and Cardiology 1, and for children and adolescents according to the relevant literature sources (Mancia et al., 2013; Vrdoljak et al., 2014; The Fourth Report on the Diagnosis, Evaluation, and Treatment of High Blood Pressure in Children and Adolescents, 2004).

Statistical analysis

Data were analyzed IBM SPSS 20.0. All the differences and correlations are commented on the significance level of $p < 0.05$. Differences in MPH indicators were analyzed using the t-test (in the case of normally distributed variables omjernog type) or non-parametric methods (Mann Whitney U test and Chi-square test), if any of these conditions is not met. In the analysis of the correlations, Pearson or Spearman's correlation coefficients are used, while pointbiserial correlation coefficient is calculated between ratio and binary variables of MPH indicators. Finally, to determine the profiles of players in each age group in MPH indicators, K-means method of clustering is used.

RESULTS AND DISCUSSION

Differences between age groups of football players for the MPH variables are presented (Table 1). Older (aged >30) football players are statistically significantly heavier and have higher BMI, higher pulse rate, systolic and diastolic blood pressure. The speed of sedimentation of red blood cells may indicate a higher incidence of chronic inflammation and inflammatory diseases, and often medication in older age groups of athletes (especially in the veteran group). Erythrocyte sedimentation rate accelerates with increasing age, after 40-years of age, and more and later (Osei-Bimpong et al., 2007; Assas et al., 2015). Older players also have lower height and lower vital capacity of the lungs, as compared with younger age group. The obtained data are consistent with the available recent findings (Reichert et al., 2009; Hanson and Jones, 2015; Börjesson, 2016; Osei-Bimpong et al., 2007; Assas et al., 2015). More favorable MSH indicators are related to the scope, intensity and continuity of physical activity, which is usually more pronounced in the young adult categories of athletes. The explanation of these results can be also found in a large gap between average age of the football players in these two age groups is very large. Older players are mostly veterans (mean age 43.84 ± 9.17), while seniors have mean age

nu tjelesnu aktivnost ima povoljni učinak na parametre zdravstvenog stanja. (Arena i Cahalin, 2014; Cléroux i sur., 1999). Prema tome, stariji igrači imaju manje poželjne MFZ osobine. Samo jedan sudionik imao je patološki nalaz pregleda pluća (u osobe starije od 30 godina), tako da je razlika između dvije dobne skupine nije bila statistički značajna. Praktična iskustva sportskog liječnika PMRS pokazuju da recipročan odnos nepovoljnih morfoloških i fizikalnih (zdravstvenih) pokazatelja vrijede i za fizikalni pregled srca, te za osnovni ortopedski odnosno neurološki pregled. Naime, patološke promjene pri fizikalnom pregledu utvrđuju se uglavnom već u mlađim dobnim skupinama (predškolska, školska i pubertetska dob). Stoga se, infekcije, alergije, kao i srčani šumovi, češće dijagnosticiraju u mlađim dobnim skupinama, prije adolescentne dobi. S aspekta ove pozitivne selekcije, može se reći da razlika u fizikalnim pokazateljima između istraživane dvije dobne skupine nogometića uglavnom ne postoje (izuzev očekivanih dobnih varijacija).

Po EKG-u, bilo je 297 sudionika u dobi 17-30 i 401 sudionik u dobi iznad 30 godina s urednim nalazom, a 64 sudionika u dobi 17-30 i 50 sudionika u dobi iznad 30 godina s patološkim nalazom. Ova razlika bila je statistički značajna ($Hi^2=7,33$; $p<0,01$; $df=1$), u smjeru češće urednih nalaza EKG za starije sudionike. Glavni uzroci nagle srčane smrti u mlađih odraslih sportaša nasljedni oblici srčanih bolesti, a u starijim dobnim skupinama (iznad 35-e godine života) bolesti koronarnih arterija. Iz navedenog slijedi da EKG (važan modalitet probira u mlađim dobnim skupinama sportaša), ima ograničenu vrijednost za skupinu starijih sportaša, kojima se preporuča individualno indicirano ergometrijsko testiranje (Schmied i Borjesson, 2014; Asif i sur., 2013; George i sur., 2012; Shephard, 2011; Giada i sur., 2011; Löllgen i sur., 2010). Kardiovaskularno remodeliranje kao posljedica intenzivnog kontinuiranog sportskog treninga se češće pojavljuje u visoko aktivnih sportaša natjecatelja, uglavnom u mlađim odraslim dobnim skupinama, te nerijetko rezultira s promjenama u nalazu EKG (fiziološka adaptacija), koje mogu nalikovati patološkim promjenama (Corrado i sur., 2009; Baggish, 2015). Praktična iskustva sportskog liječnika u PMRS ukazuju na dojam da u starijih zdravih osoba EKG ispis postaje „zrelij“ u smislu urednog nalaza, dok u mlađih odraslih osoba katkad postoji određeni nesrazmjer veličine tijela i unutrašnjih organa, uz tanji prsni koš, pa ispis EKG-a postaje „patološkiji“. S druge strane, sustavnim radom na prevenciji i obvezom pregleda sportaša uočen je relativno značajan broj specifičnih poremećaja ritmova koji ulaze u patološku kategoriju EKG-a, posebno u skupini mlađih odraslih sportaša. Na-

21.48 ± 3.51 . In addition to these reasons, unfavorable morphologic indicators could potentially reduce the physiological capacity, adversely acting on health indicators. Contrary to the above, an increase in the physiological capacity of the organism through appropriate physical activity has a favorable effect on the parameters of health. (Arena and Cahalin, 2014; Cléroux et al., 1999).

Accordingly, older players have less desirable MPH characteristics. Only one participant a negative finding of the lung examination (who was older than 30 years), thus the difference between two age groups was not statistically significant. Practical experiences of sports physician in POHS show that reciprocal relationship of adverse morphological and physical (health) indicators could be applied to the physical examination of the heart, as well as for the main orthopedic and neurological examination. Mainly, pathological changes are found already during the physical examination determined in younger age groups (pre-school, school and teenage age). Therefore, infections, allergies, and heart murmurs, are more often diagnosed in younger age groups, before the adolescence. From the point of positive selection, it can be said that the difference in physical indicators between two age groups of studied football players generally do not exist (except for the expected age variations). Therefore, the difference in physical parameters between the two groups players generally do not exist (except for the expected age variations).

According to ECG, there were 297 participants in the age 17-30 and 401 participants in the age group over 30 years of age with positive finding, and 64 participants in the age 17-30 and 50 participants in the age group over 30 years. This difference is statistically significant (Chi square= 7.33; $p<0.01$; $df=1$), in direction of relatively more positive ECG findings for older participants. The main causes of sudden cardiac death in young adult athletes are hereditary forms of heart disease, while in the older age group (over 35 years) it is coronary artery disease. It follows that the ECG (an important modality of screening in younger age groups of athletes), is of limited value for the group of older athletes, for whom is advised individually indicated exercise test (Schmied and Börjesson, 2014; Asif et al., 2013; George et al., 2012; Shephard, 2011; Giada et al., 2011; Löllgen et al., 2010). Cardiovascular remodeling, as a result of intensive continuous sports training, may be more prevalent in highly active athletes competitors, mainly in the young adult age groups, and often results in the changes in ECG findings (physiological adaptation), which may resemble pathological changes (Corrado et al., 2009; Baggish, 2015). Practical experience of sports physicians in POHS indicate the impression that the elderly healthy subjects ECG print be-

ime, promjene u EKG-u, očekivane u sportaša starijih od 30 godina, drugačije su od najčešćih značajnih promjena u mlađih odraslih sportaša (17-30 godina). U starijoj skupini dominiraju ishemische promjene, a od aritmija fibrilacija atrija. U mlađoj dobnoj skupini dominiraju urođene promjene, primjerice preekscitacija te ekstrasistolije.

comes “mature” in terms of proper ECG findings, while in young adults sometimes there is a certain discrepancy in size of the body and internal organs, with a thin chest, and printing ECG becomes “more pathologic”. On the other hand, systematic work on prevention and liability of examinations of the athletes, revealed a relatively sig-

Tablica 1. Razlike između dobnih skupina nogometasa za varijable istraživanja /
Table 1. Differences between age groups of football players for the variables in research

Variables/ Varijable	age group (year)/ dobna grupa (god.)	N	Mean/ Arit. sredina	Std. Deviation/ Std. raspršenje	Std. Error Mean/ Greška Arit. sred.	Median test (p)
height (cm)/visina	17-30	362	179.65	6.60	0.35	0.00
	>30	451	178.12	6.35	0.30	
weight (kg)/ tjal. masa	17-30	362	75.31	10.19	0.54	0.00
	>30	451	85.97	11.75	0.55	
vital cap./vitalni kap.	17-30	190	5.53	0.78	0.06	0.00
	>30	192	5.25	0.92	0.07	
pulse rate/puls mirovanja	17-30	362	59.04	10.75	0.57	0.00
	>30	451	63.61	11.08	0.52	
systolic pressure/ sist. tlak	17-30	362	119.22	11.85	0.62	0.00
	>30	451	127.98	13.05	0.61	
diastolic pressure / diast. tlak	17-30	362	71.40	8.37	0.44	0.00
	>30	451	81.44	8.84	0.42	
hemoglobin	17-30	362	146.78	8.21	0.43	0.24
	>30	451	147.69	8.08	0.38	
hematocrit/ hematokrit	17-30	362	0.44	0.02	0.00	0.11
	>30	451	0.45	0.02	0.00	
leukocyte/ leukocit	17-30	362	6.76	8.30	0.44	0.92
	>30	451	7.58	11.31	0.53	
thrombocyte/ trombocit	17-30	362	218.30	46.50	2.44	0.12
	>30	451	225.62	56.09	2.64	
sedimentation/ sedimentacija	17-30	362	4.05	2.53	0.13	0.00
	>30	451	6.02	4.04	0.19	
BMI/ ITM	17-30	361	23.30	2.64	0.14	0.00
	>30	451	27.08	3.28	0.15	

Bold: statistically significant differences at $p<0,01$ / **Podebljano:** statistički značajne razlike uz $p<0,01$

BMI/ ITM: Body Mass Index / Indeks tjelesne mase

Profili nogometasa za dva dobivena klastera i za obje dobne skupine su vrlo slični. Samo malo poželjnije osobine (s kineziološkog i medicinskog aspekta) imaju nogometari grupirani u drugim klasterima u obje dobne grupe (tablica 2). Najjednostavnije tumačenje ovih rezultata može se naći u činjenici da je većina nogometara generalno ocijenjena kao zdrava, u ovim rutinskim medicinskim pregledima.

Od 78 korelacija, 24 su bile statistički značajne u dobnoj skupini od 17-30, te 34 u dobnoj skupini > 30 (tablica 3), dok je smjer povezanosti bio u skladu s oče-

nificant number of specific disorders of the rhythms, that are included in the category of pathological ECG, especially among younger adults athletes. The changes in the ECG that are expected in athletes older than 30 years, are different from the most common significant changes in young adult athletes (17-30 years). In the older group dominated ischemic changes and arrhythmias of atrial fibrillation. In the younger age group dominated innate changes, such as excitation and extrasystolia.

The profiles of football players in both age groups, indicate that two clusters obtained are very similar. Just

Table 2. Profiles of football players, according to the variables in the study, stratified by age group /
Tablica 2. Profili nogometnika prema varijablama u istraživanju, stratificirani prema dobnoj skupini

>30		Clusters for age group Klasteri za dobu grupu	17-30	
1 st	2 nd		1 st	2 nd
177.0	180.0	height/ visina	180.4	179.0
85.54	86.47	weight/ masa	76.51	76.48
5.14	5.33	vital capacity/ vitalni kapacitet	5.60	5.40
66	63	pulse rate/ puls	57	60
129	127	systolic press./ sistolički tlak	121	120
82	80	diastolic press./ diastolički tlak	73	70
146	147	hemoglobin	147	146
0.44	0.44	hematocrit/ hematokrit	0.44	0.44
8.5	7.0	leukocyte/ leukocit	6.1	6.5
263	184	thrombocyte/ trombocit	190	264
7	5	sedimentation/ sedimentacija	4	4
22.02	24.47	BMI/ ITM	27.09	27.01
84	108	Number of Cases/ broj slučajeva	122	68

BMI/ ITM: Body Mass Index / Indeks tjelesne mase

kivanjima. Razložno tumačenje ovakvog trenda može se dati u terminima razvoja koji još nije završen za dio predstavnika mlađe dobne skupine.

Razlike i korelacije u MFZ, u različitim dobним skupinama nogometnika, prikupljeni rutinskim zdravstvenim pregledima, mogu pomoći i za kineziološke i za zdravstvene svrhe. Utvrđivanje različitih profila igrača, pomaže težnji postizanja više razine sportske izvrsnosti (primarno u pogledu optimalne fizičke spremnosti), kao i za planiranje specifičnog kineziološkog tretmana, prilagođenog određenim profilima. Ovdje su neki primjeri s nalazima nekoliko autora. Studija o dugoročnim i kratkoročnim učincima teške dinamičke vježbe na neuralnu kontrolu otkucanja srca, može objasniti koegzistenciju bradikardije uslijed treninga te znakova pojačane simpatičke aktivnosti kod treniranih vrhunskih sportaša (Furlan i sur., 1993). E/A kvocijent (omjer vršne brzine tijekom rane i kasne dijastole) ukazuje da redovita tjelesna aktivnost u starijoj dobi može štititi od dobro ovisnog smanjenja dijastoličke funkcije (Pavlik i sur., 2001). U studiji utjecaja aerobnog treninga, rezultati su otkrili da su uz poboljšanje aerobne izdržljivosti, nogometnici poboljšali svoju izvedbu povećanjem pretrčanih udaljenosti, pojačanjem intenziteta rada, te povećanjem broja sprinteva i posjeda lopte tijekom utakmice (Helgerud et al., 2001). Plan i program KT tijekom ljetnog pripremnog razdoblja promjene motoričkih sposobnosti kod nogometnika FC Rad (Beograd), rezultirao je većim ili manjim promjenama koje su se dogodile tijekom tog pripremnog razdoblja (Janjić i sur., 2010). Slično navedenome, uvidi iz ove studije mogu doprinijeti određivanju smjernica za posebnu

a bit more desirable characteristics (from kinesiological and medical aspect) have football player grouped in second clusters in both age groups (Table 2). The simplest interpretation of these results can be found in the fact that most players are generally estimated as healthy, in these routine medical examinations.

Out of 78 correlations, 24 were statistically significant in the age group 17-30, and 34 for the age group >30 (Table 3), while the direction of associations was in line with the expectations. The reasonable interpretation of this trend can be given in terms of growth that is still not completed for some representatives of the younger age group in research.

The differences and correlations in the MPH, in different age group of football players, collected from routine medical examinations, might help both for kinesiological and health purposes. Establishing different profiles of players, helps to the achieving a higher level of sports excellence (primarily optimal physical fitness), as well as for designing specific kinesiological treatment (special TP), adjusted to certain profiles. Here are some of the examples from findings of several authors. The study on the long term and short-term effects of heavy dynamic exercise on neural control of heart rate may explain the coexistence of training bradycardia, with signs of enhanced sympathetic activity in trained champion athletes (Furlan et al., 1993). E/A quotient (ratio of peak velocity during early and late diastole) suggested that regular physical activity at an older age might protect against age dependent impairment of diastolic function (Pavlik et al., 2001). In the study of the effects of ae-

Table 3. Intercorrelations between the variables in research, for certain age groups of football players /
Tablica 3. Intercorrelations između varijabli u istraživanju, za određene dobne skupine nogometnika

17-30 god.	height	weight	vital	pulse	systolic	diastolic	hemoglo	hematocr	leukocit	trombo	sedime	BMI	ECG
height/ visina	1	.543**	.450**	-.063	.123*	.051	-.040	-.054	-.044	-.134*	-.027	-.007**	.070
weight/ masa		1	.372**	.015	.222**	.148**	.066	.063	-.050	.012	.078	.834**	-.072
vital capacity/ vitalni kapacitet			1	-.032	.141	-.027	.042	.011	-.118	-.160*	-.118	.118	.023
pulse rate/ puls				1	.105*	.109*	.145**	.153**	-.046	.052	-.018	.059**	-.323**
systolic press./ sist. tlak					1	.501**	.023	.007	.008	-.036	.050	.190**	.077
diastolic press./dias.tlak						1	.161**	.118*	.069	-.061	-.003	.147**	.044
hemoglobin							1	.930**	.008	.050	-.296**	.106*	-.071
hematocrit/ hematokrit								1	.024	.058	-.299**	.109*	-.063
leukocyte/ leukocit									1	.145**	.024	-.032	-.039
thrombocyte/ trombocit										1	.190**	.102	-.070
sedimentation/ sedimentacija											1	.116*	-.024
BMI/ ITM												1	-.129*
ECG/ EKG													1
>30 god.	height	weight	vital	pulse	systolic	diastolic	hemoglo	hematocr	leukocit	trombo	sedime	BMI	ECG
height/ visina	1	.444**	.352**	-.104*	-.058	-.038	-.013	.030	-.003	-.182**	-.021	-.088	.115*
weight/ masa		1	.083	.124**	.219**	.271**	.176**	.209**	-.063	-.013	.038	.850**	-.018
vital capacity/ vitalni kapacitet			1	-.036	-.138	-.108	.086	.115	.045	-.044	.039	.105	-.037
pulse rate/ puls				1	.214**	.238**	.183**	.208**	.159**	.108*	.105*	.203**	-.300**
systolic pressure					1	.726**	.085	.092	-.024	.043	.065	.282**	-.084
diastolic pressure						1	.159**	.151**	-.017	.055	.106*	.329**	-.077
hemoglobin							1	.896**	.037	-.057	-.292**	.209**	-.148**
hematocrit/ hematokrit								1	.083	-.039	-.281**	.218**	-.140**
leukocyte/ leukocit									1	.035	-.007	-.076	-.051
thrombocyte/ trombocit										1	.250**	-.094*	-.042
sedimentation/ sedimentacija											1	.005	.028
BMI/ ITM												1	-.089
ECG/ EKG													1

** correlation statistically significant at $p<0,01$ / * correlation statistically significant at $p<0,05$

** korelacija statistički značajna uz $p<0,01$ / * korelacija statistički značajna uz $p<0,05$

BMI/ ITM: Body Mass Index / Indeks tjelesne mase; ECG/ EKG: electrocardiogram / elektrokardiogram

pozornost liječnika u izvanbolničkoj medicini i u sportu, kada promatra igrače u danim dobnim skupinama.

ZAKLJUČCI

Pronađeno je nekoliko statistički značajnih razlika u MFZ karateristikama između dvije dobne skupine, uglavnom u smjeru poželjnijih obilježja u mlađoj dobroj skupini, koje su objašnjene u smislu velikog udjela veterana u starijoj dobroj skupini. Međutim, načelno se može reći da rutinski medicinski pregledi u mlađim dobnim skupinama sportaša dovode do njihove pozitivne selekcije, u smislu poželjnih zdravstvenih pokazatelja. Stoga se sve razlike dobivene u ovoj studiji mogu objasniti uo-

robic training, the results revealed that enhanced aerobic endurance in football players improved their performance by increasing the distance covered, enhancing work intensity, and increasing the number of sprints and ball possession during a match (Helgerud et al., 2001). ET plan and program during the summer preparation period on motor abilities changes in football players of FC Rad (Belgrade) resulted with the major or minor changes that occur during this preparation period (Janjić et al., 2010).

Similarly, the insights from this study can contribute to determine the guidelines for special attention of physicians in outpatient medicine and sport, when observing players in given age groups.

bičajenim fiziološkim promjenama, karakterističnim za dobne skupine sportaša (npr. recipročan odnos nepovoljnih morfoloških i fizikalnih (zdravstvenih) pokazatelja). Uvidi iz ove studije djelomično doprinose razumijevanju i praktičnoj primjeni rutinskih pregleda u ambulantama medicine rada i sporta, za poboljšanje mjera primarne i sekundarne prevencije poremećaja u zdravstvenom statusu sportaša.

Popis kratica korištenih u tekstu:

MFZ - morfološki, fiziološki i zdravstveni pokazatelji

AN - antropometrijske karakteristike

FI - fiziološke karakteristike

VO_{2max} - maksimalni aerobni kapacitet ili maksimalni primitak kisika

KT - kondicijski trening

VI - vezni igrači (VI)

M±SD - aritmetička sredina / standardna devijacija (raspršenje)

PMRS - Poliklinika za medicinu rada i sporta Zagrebačkog športskog saveza s medicinsko-biokemijskim laboratorijem u Zagrebu

CONCLUSIONS

Several differences in MPH are found between two age groups, mainly in direction more desirable features in younger age group, which are explained in terms of large share of veterans in older age group. However, in principle, it can be said that a routine medical examination in early age of the athletes, bring to their positive selection, in terms of desirable health indicators. Therefore, all differences obtained in this study can be explained by the physiological changes characteristic of the age group of athletes (eg. a reciprocal relationship adverse morphological and physical (health) indicators). Findings from this study partially contribute to the understanding and practical application of medical examinations in outpatient medicine and sport, improving the measures of primary and secondary prevention of disorders in the health status of the athletes.

Abbreviations used in text:

MPH - morphological, physiological and health indicators

AN - anthropometric characteristics

PI - physiological characteristics

VO_{2max} - maximal aerobic capacity or maximum oxygen uptake

ET - exercise training

MP - midfielders (VI)

M ± SD - mean / standard deviation (scattering)

POHS - Polyclinic for Occupational Health and Sport of Zagreb Sports Association with clinical laboratory in Zagreb

LITERATURA / REFERENCES

- Arena, R., & Cahalin, L.P. (2014). Evaluation of cardiorespiratory fitness and respiratory muscle function in the obese population. *Progress in Cardiovascular Diseases*, 56(4), 457-464.
- Asif, I.M., Rao, A.L., & Drezner, J.A. (2013). Sudden cardiac death in young athletes: what is the role of screening? *Current Opinion in Cardiology*, 28(1), 55-62.
- Assasi, N., Blackhouse, G., Campbell, K., Hopkins, K.B., Levine, M., Richter, T., & Budden, A. (2015). *Comparative Value of Erythrocyte Sedimentation Rate (ESR) and C-Reactive Protein (CRP) Testing in Combination Versus Individually for the Diagnosis of Undifferentiated Patients With Suspected Inflammatory Disease or Serious Infection: A Systematic Review and Economic Analysis Cadth Health Technology Assessment, No. 140*. Ottawa (ON): Canadian Agency for Drugs and Technologies in Health.
- Bangsbo, J., Mohr, M., & Krstrup, P. (2006). Physical and metabolic demands of training and match-play in the elite football player. *Journal of Sports Sciences*, 24(7), 665-674.
- Baggish, A.L. (2015). A decade of athlete ECG criteria: where we've come and where we're going. *Journal of Electrocardiology*, 48(3), 324-328.
- Bangsbo, J. (1994). The physiology of football— with special reference to intense intermittent exercise. *Acta Physiologica Scandinavica*, 15(s619):1-156.
- Bertagnolli, M., Schenkel, P.C., Campos, C., Mostarda, C.T., Casarini, D.E., Belló-Klein, A., Irigoyen, C.M., & Rigatto, K. (2008). Exercise training reduces sympathetic modulation on cardiovascular system and cardiac oxidative stress in spontaneously hypertensive rats. *American Journal of Hypertension*, 21, 1188-1193.
- Börjesson, M., Onerup, A., Lundqvist, S., & Dahlöf, B. (2016). Physical activity and exercise lower blood pressure in individuals with hypertension: narrative review of 27 RCTs. *British Journal of Sports Medicine*, 50(6), 356-361.
- Carson, K.V., Chandratilleke, M.G., Picot, J., Brinn, M.P., Esterman, A.J., & Smith, B.J. (2013). Physical training for asthma. *The Cochrane Database of Systematic Reviews*, 30; 9: CD001116.
- Casajus, J.A. (2001). Seasons variation in fitness variables in professional football players. *Journal of Sports Medicine and Physical Fitness*, 41(4), 463-469.
- Cléroux, J., Feldman, R.D., & Petrella, R.J. (1999). Lifestyle modifications to prevent and control hypertension. 4. Recommendations on physical exercise training. Canadian Hypertension Society, Canadian Coalition for High Blood Pressure Prevention and Control, Laboratory Centre for Disease Control at Health Canada, Heart and Stroke Foundation of Canada. *Canadian Medical Association Journal*, 160(9S), 21-28.
- Corrado, D., Biffi, A., Basso, C., Pelliccia, A., & Thiene, G. (2009). 12-lead ECG in the athlete: physiological versus pathological abnormalities. *British Journal of Sports Medicine*, 43(9), 669-676.
- Furlan, R., Piazza, S., Dell'Orto, S., Gentile, E., Cerutti, S., Pagani, M., & Malliani, A. (1993). Early and late effects of exercise and athletic training on neural mechanisms controlling heart rate. *Cardiovascular Research*, 27, 482-488. Epub 1993/03/01.
- George, K., Whyte, G.P., Green, D.J., Oxborough, D., Shave, R.E., Gaze, D., & Somauroo, J. (2012). The endurance athletes heart: acute stress and chronic adaptation. *British Journal of Sports Medicine*, 46(1), 29-36.
- Giada, F., Conte, R., Pescatore, V., & Brugia, E. (2011). Sports and arrhythmias. *Minerva Medica*, 102(3), 239-247.
- Gokhan, I., Kurkcu, R., & Cekin, R. (2013). Comparison of Blood Lipids, Blood Pressures and Left Ventricular Cavity Dimension between Football Players and Non-Athletes. *Educational Research Review*, 8(15), 1310-1313.
- Hanson, S., & Jones, A. (2015). Is there evidence that walking groups have health benefits? A systematic review and meta-analysis. *British Journal of Sports Medicine*, 49(11), 710-715.
- Helgerud, J., Engen, L.C., Wisloff, U., & Hof, J. (2001). Aerobic endurance training improves football performance. *Medicine & Science in Sports & Exercise*, 33(11), 1925-1931.
- Janjić, A., Suzović, D., & Janković, A. (2010). The motor abilities change of football players during the summer preparation period. *Physical Culture*, 64(1):35-45.
- Kalapotharakos, V., Strimpakos, N., Vithoulka, I., Karvounidis, C., Diamantopoulos, K., & Kapreli, E. (2006). Physiological characteristics of elite professional football teams of different ranking. *Journal of Sports Medicine and Physical Fitness*, 46, 515-519.
- Löllgen, H., Leyk, D., & Hansel, J. (2010). The pre-participation examination for leisure time physical activity: general medical and cardiological issues. *Deutsches Ärzteblatt International*, 107(42), 742-749.

- Mancia, G., De Backer, G., Dominiczak, A., Cifkova, R., Germano, G., Grassi, G. et al. (2007). Guidelines for the Management of Arterial Hypertension: The Task Force for the Management of Arterial Hypertension of the European Society of Hypertension (ESH) and of the European Society of Cardiology (ESC). *Journal of Hypertension*, 25, 1105-1187.
- Milanović, D. (Ed.) (1997). *Priručnik za sportske trenere*. Zagreb: Faculty of Kinesiology, University of Zagreb. [In Croatian]
- Osei-Bimpong, A., Meek, J.H., & Lewis, S.M. (2007). ESR or CRP? A comparison of their clinical utility. *Hematology*, 12(4), 353-357.
- Pavlik, G., Olexo, Z., Osvath, P., Sido, Z., & Frenki, R. (2001). Echocardiographic characteristics of male athletes of different age. *British Journal of Sports Medicine*, 35, 95-99.
- Reichert, F.F., Baptista Menezes, A.M., Wells, J.C., Carvalho Dumith, S., & Hallal, P.C. (2009). Physical activity as a predictor of adolescent body fatness: a systematic review. *Sports Medicine*, 39(4), 279-294.
- Reillyly, T., Bangsbo, J., & Franks, A. (2000). Anthropometric and physiological predispositions for elite football. *Journal of Sports Sciences*, 18, 669-683.
- Shephard, R.J. (2011). Mandatory ECG screening of athletes: is this question now resolved? *Sports Medicine*, 41(12), 989-1002.
- Schmied, C., & Borjesson, M. (2014). Sudden cardiac death in athletes. *Journal of Internal Medicine*, 275(2), 93-103.
- The Fourth Report on the Diagnosis, Evaluation, and Treatment of High Blood Pressure in Children and Adolescents. (2004). *Pediatrics*, 2(3), 555-576.
- Vrdoljak, A., Željković Vrkić, T., Kos, J., Premužić, V., Laganović, M., & Jelaković, B. (2014). Mjerenje arterijskog tlaka – ne mari za male stvari i ostat će male stvari?! Preporuke Hrvatskoga referalnog centra za hipertenziju centra izvrsnosti Europskog društva za hipertenziju. *Liječnički Vjesnik*, 136, 33–43. [In Croatian]

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