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DRAGI ČITAOCI,

Sa radošću i velikim zadovoljstvom vam predstavljamo novi broj časopisa Sportske nauke i zdravlje za koji je pristigao veći broj radova naših saradnika iz Bosne i Hercegovine i regiona. Zainteresovanost naših kolega za saradnju i objavljivanje radova u našem časopisu se konstantno povećava i sve je veći broj radova koji pristižu na našu adresu. Zainteresovanost naučnih radnika za publikovanjem radova u našem časopisu potvrđuju opravdanost postojanja časopisa kao značajnog naučno-edukativnog projekta i svjedoka novog vremena i novih potreba.

Na žalost, u ovom broju nismo u mogućnosti objaviti sve pristigle radove, te se ovom prilikom izvinjavamo kolegama čiji radovi nisu objavljeni u ovom broju. Isto tako, neke radove nismo objavili, jer nisu u potpunosti zadovoljili potrebne standarde našeg časopisa, jer nam je cilj konstantno napredovanje i uspostavljanje novih sistema vrijednosti po kojem želimo biti prepoznatljivi u svijetu nauke. Takođe, ističemo našu spremnost za saradnju i razmjenu iskustava sa srodnim časopisima, što će sigurni smo, doprinostiti većoj publikaciji i zainteresovanosti saradnika za još bolju i kvalitetniju saradnju. Uvjereni smo da ćemo zajedno sa vama uspjeti ostvariti visoko postavljene standarde i ciljeve.

Kao i u prethodnim brojevima u časopisu možete pronaći radove iz različitih oblasti sportskih i zdravstvenih nauka: fiziološko-medicinske aspekte fizičke aktivnosti, biomehanike sporta, boričkih vještina, školskog sporta itd.

U ovom broju možete pročitati vrlo interesantne naučne radove koji se odnose na razlike u metaboličko-energetskim potencijalima fudbalera kadetskog uzrasta u odnosu na takmičarski nivo, usporedbu maksimalnog primitka kisika (VO_2 max) djevojčica dobi 10 i 14 godina. Takođe, tu su i radovi koji se odnose na analizu tjelesnog sastava karatista bioelektričnom impedansom prije i poslije pripremnog perioda, te metrijske karakteristike testova za procjenu koordinacionih sposobnosti u plesu, stanje uhranjenosti djece predškolskog uzrasta, itd.

Želimo se zahvaliti svim našim saradnicima što svojim aktivnim učešćem, sugestijama i primjedbama pomažu radu časopisa i na taj način omogućuju njegovu još veću raferentnost i kvalitet.

Uvjereni smo da ćemo i ubuduće sarađivati i zajedno sa vama uspjeti ostvariti visoko postavljene standarde i ciljeve.

Koristimo priliku i da vam čestitamo Novu 2017. godinu sa puno dobrog zdravlja i uspjeha u svakom segmentu života.

UREDNIŠTVO ČASOPISA

DEAR READERS,

With great joy and pleasure we would like to present the new issue of Journal Sports Science and Health with lots of works from our colleagues from Bosnia and Herzegovina and the region. The interest of our colleagues for cooperation and paper publication in our magazine is constantly increasing and there is a growing number of papers that are coming to our address. The interest of scientists to publish papers in our Journal confirms the validity of Journal as an important scientific and educational project and a witness of the new times and new needs.

Unfortunately, in this Journal issue we are not able to publish all the papers, and we would like to use this opportunity to apologize to all those colleagues whose works have not been published in this issue. Furthermore, some papers have not been published because they do not fully meet the required standards of our Journal, since our goal is constant improvement and establishment of new system of values by which we want to be recognized in the world of science. We also want to emphasize our readiness for cooperation and experience exchange with similar Journals, which will most certainly contribute to the increased interest in publication and colleague interest in even better and more qualified cooperation. We are certain that together we will achieve high standards and goals.

As in the previous issues of this Journal, you can find papers from different areas of sport and health sciences: physiological and medical aspects of physical activity, biomechanics of sports, martial arts, school sports, etc.

In this Journal issue you can read some very interesting scientific papers which deal with differences in metabolic energy potential players at the cadet level in relation to the level of competition, comparison of the maximum oxygen consumption (VO_2 max) of girls aged 10 and 14 years. Also, there are papers that deal with the analysis of body composition karate bioelectrical impedance before and after the preliminary period, and psychometric characteristics of tests for the evaluation of coordination skills in dance, the nutritional status of children of preschool age, etc.

We want to thank to all of our colleagues for their active participation, suggestions and comments in order to help Journal and thus enable its even greater references and quality. We are certain that we will continue to cooperate with you to achieve high standards and goals. We use the opportunity to wish you Happy New Year 2017 with lots of health and success in every aspect of life.

JOURNAL EDITORIAL

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BIOELECTRICAL IMPEDANCE ANALYSIS OF BODY COMPOSITION IN KARATE ATHLETES REGARDING THE PREPARATORY PERIOD

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Abstract: The aim of the paper was to assess changes in body composition using bioelectrical impedance analysis (BIA) methodology in members of national karate team after ten week preparatory training period. The investigation was carried out on 11 male karate contestants, aged 18 to 28 years mean age (21.82 ± 3.58). The body composition was analyzed with In Body 720. The BIA outcomes were divided in 3 group of variables: body fluid and body composition variables, obesity diagnose variables and segmental analysis variables. All BIA variables were insignificantly higher at second measuring ($p > 0.05$). Only Body mass index ($BMI = 24.1$ vs 24.55); mineral (4.69 kg vs 4.77 kg) and osseous (3.85 kg vs 3.92 kg), were significantly higher ($p \leq 0.05$) after preparatory period. Body fat mass ($BFM = 10.34$ kg vs 10.75 kg, $p = 0.329$) and body fat percent ($BF\% = 12.73$ vs 13.22%) insignificantly increased after preparatory period. The skeletal mass has changed from 40.03 kg to 40.55 kg ($p = 0.276$). Body composition analysis, changes in weight, BMI and body fluids are essential for weight categories dependent sports such as karate. Positive changes in body components and in body fluids suggest that the training process during the preparatory period did not show negative effects on body components and the hydration of the karate athletes.

Key words: body composition, bioelectrical impedance, body fluids, karate

ANALIZA TELESNOG SASTAVA KARATISTA BIOELEKTRIČNOM IMPEDANSOM PRE I POSLE PRIPREMNOG PERIODA

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Apstrakt: Cilj ovog rada je da se izvrši analiza promena telesnog sastava kod članova nacionalne karate reprezentacije Republike Makedonije, pomoću bioelektrične impedance (BIA metoda), posle pripremnog perioda od deset (10) sedmica. U istraživanju je učestvovalo 11 članova reprezentacije Republike Makedonije, prosečnog uzrasta 21.82 ± 3.58 godina. Telesni sastav je analiziran pomoću aparata In Body 720. Parametri koji predstavljaju krajnji rezultat ovog aparata su podeljeni u 3 grupe: telesne tečnosti i telesne komponente; parametri dijagnoze gojaznosti i parametri segmentarne analize. Većina BIA parametara su viši, ali statistički neznačajno, pri drugom merenju ($p > 0.05$). Jedino su indeksi telesne uhranjenosti ($BMI = 24.1$ vs 24.55); mineralna masa (4.69 kg vs 4.77 kg) i koštana masa (3.85 kg vs 3.92 kg), bili značajno veći ($p \leq 0.05$) posle pripremnog perioda. Količina telesne masti ($BFM = 10.34$ kg vs 10.75 kg, $p = 0.329$) i procenat telesne masti ($BF\% = 12.73$ vs 13.22%) su neznatno viši posle pripremnog perioda. Skeletna mišićna masa (SMM) se promenila za neznatnih 0.5 kg [40.03 kg do 40.55 kg ($p = 0.276$)]. Analiza telesnog sastava i telesnih tečnosti je od suštinske važnosti za sportske grane kao što je karate, čiji takmičari pripadaju različitim težinskim kategorijama. Naše istraživanje je pokazalo da su sve telesne komponente ostale nepromenjene. Značajno je što nije ustanovljeno smanjenje količine telesnih tečnosti, što ukazuje na to da su sportisti bili dobro hidrirani tokom pripremnog perioda.

Ključne reči: telesni sastav, bioelektrična impedansa, telesne tečnosti, karate

INTRODUCTION

Biomechanical and physiological requirements of karate training regime affect the athlete's body composition, especially musculoskeletal system and body fat mass (Szeligowski, 2010; Imamura, Yoshimura, Uchida, Nishimura, & Nakazawa, 1998). A great number of methods have been used in order to perform accurate evaluation and valid comparison analyzes of different anthropometric indices and body composition in martial arts practitioners (Pieter, Bercades, & Kim, 2006; Amusa & Onyewadume, 2001; Koropanovski et al., 2011).

Bioelectrical impedance analysis (BIA) has potential in the area of sports and exercise as a method for evaluation of body composition in different groups of athletes. However, according to other authors, the BIA method is insufficient in registering small changes in body fat component (BF %) in the subject, which could prove as a great deficiency for its use in athletes. The reports on BIA measurements in athletes, available in the literature suggest that there is a need for rigorous control of the ambient variables (such as hydration, temperature, food intake and the training regime before the measurements) in which the measurements are performed (Dehghan & Merchant, 2008). The data on body fluids that are obtained by BIA method are very useful for athletes who compete in weight categories and who use dehydration methods in order to lose weight as well as for athletes who train and compete in extreme external conditions.

The present study was conducted with an aim to determine body components and other parameters that derive from the BIA measurements in a group of elite karate players in the Republic of Macedonia before and after a preparation period.

METHODS

Study sample

The research was carried out in a group of eleven (11) male elite karate athletes, members of Macedonian national team, aged from 18 to 28 years. All of them had trained karate for more than 8 years, with average 8 ± 2.7 years of experience. None of them reported any medical problems or recent injuries. The study was approved by the Ethical Committee for research on humans of the Medical Faculty, UKIM, Skopje, The Republic of Macedonia. Prior to the measurements all participants received a complete explanation regarding the purpose and procedures of the research. They signed an informed consent document according to the Helsinki Declaration.

Eleven members of the Macedonian karate national team, aged 18 to 28 years, with a mean age of 21.8 ± 3.57 years, were examined on the start and on the end of the preparatory period which lasted ten weeks and was aimed for their participation on the World Karate Championship. The athletes were divided in weight categories:

Assessment of body composition

Body composition was diagnosed by the In Body 720, multi-frequency (1-1000 kHz) bioelectrical impedance analyzer (BIA). According to this method body mass is divided into three components: total body water (TW), fat free mass (FFM) and body fat (BF). In Body 720 employs eight contact electrodes: two are positioned on the palm and the thumb, another two on the front of the foot's heel which enables segmental analysis of the five basic body parts (upper and lower extremities and trunk). The measurement was performed under laboratory conditions according the user manual instructions (In Body 720). Time consumption for measurements is between one and two minutes.

The preparatory training period of the athletes was 10 weeks long, including general fitness training and specific fitness training, and lasted from 10th July 2015 to 20th September 2015. The measurements were performed in the morning hours on empty stomach and before training.

The final results of the body composition measurements with the BIA methods could be shown in three groups of parameters.

Body fluid and body component's variables: Intracellular water (ICW); extracellular water (ECW); Total Body water (TBW); protein; mineral; osseous; skeletal muscle; Fat free mass (FFM); soft lean mass (SLM).

Obesity diagnose variables: body mass index (BMI); Body fat mass; body fat percent, waist hip ratio (WHR).

Segmental analysis variables: right arm, left arm; trunk, right leg, left leg.

Statistics: BIA parameters obtained during the first and during the second measurement are presented as central and dispersive statistical parameters: mean values, standard deviation and standard error. The dependent Sample (Paired – Sample) T test was used to test the differences between the variables in two different occasions, before and after training process. The level of significance was set at 0.05. The SPSS statistical software was used, version 20 (Chicago, Illinois, USA).

RESULTS

Basic anthropometric characteristics of the research group are shown in table 1. The age of the subjects varied within the interval of 21.82 ± 3.58 years; $\pm 95.00\%CI$: 19.64-21.70; minimal age being 18 years while maximal age was 28 years.

Table 1. Descriptive statistics of general characteristics of karate athletes

	Mean	Confidence -95.00%	Confidence +95.00%	Minimum	Maximum	Std. Dev.
Age (year)	21.82	19.64	21.70	18	28	3.58
Height (cm)	181.95	176.12	181.97	175.5	191.00	6.59
Weight (kg)	80.21	72.97	84.20	69.00	111.70	11.42

During the first measurements the athletes' average weight was 80.21 ± 11.42 kg, while after the preparatory training regime it was 81.05 ± 11.5 kg. The standard deviation during the two measurements is large because of the wide range of the weight categories in which the athletes compete.

The body fluid and the body components variables of the karate athletes before (1) and after (2) ten weeks preparatory period are shown in table 2. Total body water, as well as its components- intracellular and extracellular water were insignificantly higher after the preparatory period. All body composition components which constitute the active body mass part: protein, skeletal mass, osseous and mineral, were higher after preparatory period, but only osseous and mineral were significantly higher.

The variables of obesity diagnose are shown in table 3. Body fat mass and body fat percent were insignificantly higher after preparatory period. The waist hip ratio was the same at both measurements (0.82). The segmental analysis of extremities and trunk are shown in table 4. Analysis of differences of segmental analysis variables showed that all the changes were inconsistent and insignificant ($p > 0.005$).

Table 2. Body fluid and body components BIA variables of karate athletes before (1) and after (2) ten weeks preparatory period

Body fluid and body components (kg)	Mean	Standard deviation	Std. error mean	Paired differences	Paired correlations
ICW1	32.23	4.33	1.30		$r = 0.995$
ICW2	32.37	4.55	1.37	0.341	$P = 0.000$
ECW1	19.04	2.82	0.85		$r = 0.993$
ECW2	19.2	2.79	0.84	0.540	$P = 0.000$
TBW1	51.27	7.13	2.15		$r = 0.995$
TBW2	51.48	7.33	2.21	0.389	$P = 0.000$
Protein1	13.92	1.89	0.59		$r = 0.995$
Protein 2	13.98	1.98	0.57	0.432	$P = 0.000$
Mineral 1	4.69	0.65	0.20		$r = 0.994$
Mineral 2	4.77	0.69	0.21	0.007*	$P = 0.000$
Osseous 1	3.85	0.55	0.16		$r = 0.995$
Osseous 2	3.92	0.57	0.17	0.003*	$P = 0.000$
FFM 1	69.87	9.65	2.91		$r = 0.995$
FFM2	70.25	9.39	2.83	0.238	$P = 0.000$
Soft Lean Mass 1	66.03	9.12	2.75		$r = 0.995$
Soft Lean Mass 2	66.33	9.39	2.83	0.328	$P = 0.000$
Skeletal mass 1	40.03	5.64	1.70		$r = 0.996$
Skeletal mass 2	40.55	5.96	1.80	0.276	$P = 0.000$

Table 3. Obesity diagnose variables of karate athletes before (1) and after (2) ten weeks preparatory period

Obesity diagnose	Mean	Standard deviation	Std. error mean	Paired differences	Paired correlations
BF mass 1	10.34 kg	4.11	1.24		r= 0.945
BF mass 2	10.75 kg	3.82	1.15	0.329	P= 0.000
BMI 1	24.21	2.21	0.67		r= 0.971
BMI 2	24.55	2.15	0.65	0.05*	P= 0.000
BF % 1	12.73 %	4.39	1.32		r= 0.939
BF % 2	13.22 %	3.98	1.20	0.307	P= 0.000
WHR 1	0.82	0.04	0.01		r= 0.912
WHR 2	0.82	0.05	0.01	0.572	P= 0.000

Table 4. Segmental analysis variables of karate athletes before (1) and after (2) ten weeks preparatory period

Segmental analysis (kg)	Mean	Standard deviation	Std. error mean	Paired differences	Paired correlations
Right arm 1	4.08	0.78	0.24		r= 0.991
Right arm 2	4.06	0.77	0.32	0.591	P= 0.000
Left arm 1	4.01	0.74	0.22		r= 0.979
Left arm 2	4.01	0.73	0.22	0.938	P= 0.000
Trunk 1	28.12	9.5	2.86		r= 0.642
Trunk 2	30.43	4.25	1.28	0.332	P= 0.033
Right leg 1	10.94	4.25	0.45		r= 0.962
Right leg 2	10.95	3.26	0.46	0.341	P= 0.000
Left leg 1	10.94	1.36	0.41		r= 0.992
Left leg 2	10.83	1.39	0.42	0.078	P= 0.000

DISCUSSION

The athletes who compete in weight class sports such as karate, judo wrestling, boxing, and weightlifting are commonly faced with a reduction of body weight. In the available literature, there is a small number of reports on body composition of athletes who compete in these sports, although it is common opinion that the body composition is essential for them. These reports are most needed in order to make an international database which could be used for comparison and evaluation between teams and individuals. To our knowledge, this study obtained the first results regarding the body composition and its changes during the preparatory training regime in Macedonian karate contestants.

There are five weight categories among senior karate male athletes: <60 kg, <67, <75, <84 kg and >84 kg. Within each weight category it is most essential whether the weight of the individual athlete has changed and if it has - how many kilograms. Although it is logical to expect that the athletes' weight would decrease after a relatively long preparatory period (ten weeks), the mean weight of the group increased 0.9 kg. Out of eleven athletes, eight had increased their weight. Most of them (six athletes) had increased their weight for 1.2 kg. Only three athletes had decreased their weight in a range of 0.7 to 2 kg. The reason for this increment of the weight could be the fact that all of those who had increased their weight did not have any difficulties to stay in their category.

One of the advantages of the BIA method is the fact that the content of the body water could be estimated. There was mild non-significant increment of total body water and her components ICW and ECW in karate athletes in our study. This result could be due to the mild increment of the muscle component. This positive change of the body compartments suggests good hydration (euhydration) of Macedonian karate athletes.

There was a small significant increment of the absolute values of the components that comprise the bone tissue (mineral and osseous) after the preparatory period in karate athletes in our study. This result is in accordance with the

reports of other studies that suggest that the sports with high impact increase the density of the bones (Andreoli et al., 2008; Drozdowska et al., 2011).

Mean age of the athletes in our study was 21.8 (3.57) years, while most of them (eight out of eleven) were younger than 23 years. This fact implies that they are still in the phase of growth and development of the skeletal system.

The body mass index (BMI) is a numeric indicator of the nutritional status and the level of obesity of the subject. The BMI could show increased values due to larger muscle mass and consequently higher body weight compared to body height in athletes. Subjects in our study showed similar BMI values compared to data for karate athletes in the literature. Polish male karate athletes with similar general characteristics as our subjects (age 23.5 ± 4.67 years; height 1.80 ± 0.07 m; weight 81.4 ± 11.99 kg) amounted similar values for BMI (24.9 ± 1.74) and FFM (68.5 ± 9.76 kg) and higher body fat percentage (16.8 ± 2.51) (Sterkowicz-Przybycien, 2010). Reports from different study in Poland showed similar BMI values regarding the beginning and the end of the preparatory period (23.1 vs 23.4 kg/m²) in male karate contestants: during 23.5 ± 2.414 kg/m² and the start period 23.44 ± 2.38 kg/m² (Gloc, Plewa, & Nowak, 2012).

Koropanovski et al. (2011) reported an analysis of anthropometrics and physical performance in 31 male karate competitors of the Serbian national karate team. The athletes were at similar age as our subject and had lower BMI compared to our results (24.55 ± 2.1 kg/m²). The mean age of male karate athletes was 21.0 ± 2.8 years and their BMI amounted to 23.5 ± 2.1 kg/m². Kata group in turn, was 20.7 ± 4.4 years of age and their BMI amounted to 23.2 ± 1.8 kg/m².

The body fat is the passive part of body mass and it is usually targeted for decreasing. Body fat may act as ballast in biomechanical terms, but adipose tissues are vital endocrine organ in terms of general health (Ackland et al., 2012). Despite a great methodological and technological advances in measuring of human body composition there is still no gold standard for body fat assessment with accuracy better than 1%. Body fat percent in karate contestants in our study (BF%=12.7% vs 13.22% was similar to values reported by other researchers. The body fat percentage range of top-level karate athletes extends from approximately 10.7 ± 2 for Japanese (Raschka, Bousomnita, & Preiss, 2005), 13.7 ± 4.1 for French, 14.1 ± 3.46 , to the highest values for British $16.5 \pm 4.6\%$ and Polish international level contestants 16.8 ± 2.5 (Imamura et al., 1998; Brozek et al., 1963; Chaabene, Hahcana, Franchini, Mkaouer, & Chamari, 2012). It is noteworthy that adiposity of karate fighters increased in the heavier weight categories (Raschka et al., 2005).

Intensive training regime during the preparatory period could lead to decrement of body fat mass and of the body fat percent in athletes; nevertheless it was not the case in our study. One of the possible explanations of the insignificant increment of these components in our subjects could be the insufficiency of BIA method in detection of small changes in body fat component (Kyle, Bosaeus, De Lorenzo, & Deurenberg, 2004). Furthermore, it is common fact that the athletes who start the training regime during the preparatory period are still in good physical fitness, therefore the values of their body fat components are within referent values for their sport and their age. One of the most undesirable explanations for these results could be that the regimes of nutrition and training haven't been appropriate for the preparatory period.

Although there is a strong agreement about the significance of body composition for those sports such as karate, there is a very small number of reports regarding this issue. Based on the deficit of reports about karate athletes regarding body composition, we will refer to studies which included other fighting sports. The skinfold thickness method was the most frequently used method of body composition measurements in the majority of reported studies (Andreato et al., 2012). Investigation of aerobic and anaerobic endurance after five week preparatory period in elite judo athletes showed insignificant decrement of body mass (85.7 kg to 85.3 kg), decrement of BMI (27.4 to 27.3) and of fat percent (14.6% to 14.2%). Only the fat free mass (FFM) was increased (71.7 kg to 72.6 kg) which was in accordance with the results from our study (Borowiak, Norkowski, Woznika, Keska, & Tkaczyk, 2012).

The segmental analysis showed that there was no statistically significant difference between the values for the right and for the left extremities (right arm/left arm and right leg/left leg) in our subjects. The change of the parts of the extremities regarding the preparatory period is insignificant. Segmental and total bone mineral density were measured by Andreoli et al. (2001) in judo, karate and water-polo athletes, and the study has shown that athletes engaged in high impact sports have significantly higher total bone mass and bone mass density.

CONCLUSION

Positive changes in body components and body fluids are registered in athlete members of the Macedonian karate national team. The training process during the preparatory period does not have negative effect on body components and the level of hydration in karate athletes. The preparatory training regime does not significantly alter athletes' body composition (except for the osseous and the mineral component).

Authorship statement

The authors have contributed equally.

Financial disclosure

We declare that we have no conflicts of interest.

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METRIJSKE KARAKTERISTIKE TESTOVA ZA PROCJENU KOORDINACIONIH SPOSOBNOSTI U PLESU

METRIC CHARACTERISTICS OF TESTS FOR ASSESSMENT OF COORDINATION SKILLS IN DANCE

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Apstrakt: Istraživanje je provedeno na uzorku od 36 ispitanika polaznika plesnog kluba „Gemma“ iz Banja Luke, podijeljenih kao 18 plesnih parova (18 dječaka i 18 djevojčica). Istraživanjem su obuhvaćeni ispitanici muškog i ženskog pola uzrasta 12 do 13 godina koji po kategorizaciji Plesnog saveza Bosne i Hercegovine pripadaju kategoriji mladih juniora. U istraživanju su provjerene metrijske karakteristike testova za procjenu koordinacionih sposobnosti cijelog tijela i specifičnih koordinacionih sposobnosti u ritmu.

Osnovni cilj istraživanja je bio da se utvrde metrijske karakteristike mjernih instrumenata (testova) za procjenu koordinacionih sposobnosti mladih juniora u plesu.

Na osnovu izračunatih metrijskih karakteristika mjernih instrumenata (testova) za procjenu koordinacionih sposobnosti može se konstatovati da gotovo svi testovi kojima se procjenjuju koordinacione sposobnosti imaju vrlo dobre metrijske karakteristike, jer su koeficijenti pouzdanosti dosta visoki i kreću se u intervalu od 0.93 do 0.99. S obzirom na vrlo kvalitetne strukture korelacionih matrica čestica (itema) i njihove projekcije na prvu glavnu komponentu može se konstatovati da sve čestice (itemi) svakog pojedinog mjerenja pripadaju jednom manifestnom zajedničkom prostoru što ukazuje na to da su testovi mjerili ono što se htjelo mjeriti.

Na osnovu dobijenih rezultata u ovom istraživanju preporučuje se korištenje primijenjenih testova kako za potrebe dijagnostikovanja koordinacionih sposobnosti u plesu, tako i za programiranje trenažnog rada plesača.

Ključne riječi: koordinacione sposobnosti, metrijske karakteristike, plesači.

Abstract: The research was conducted on a sample of 36 participants, students of the dance club “Gemma” from Banja Luka, divided as 18 dance couples (18 boys and 18 girls). The research includes participants of masculine and feminine genders, between 12 and 13 years of age that belong to the category of young juniors according to the categorisation of the Bosnia and Herzegovina Dance Association. The research validated metric characteristics of tests for assessment of coordination skills of the whole body and specific coordination skills in rhythm.

The main objective of the research was to determine metric characteristics of measuring instruments (tests) for assessment of coordination skills of young juniors in dance. Based on the calculated metric characteristics of measuring instruments (tests) for assessment of coordination skills, it can be stated that almost all the tests assessing coordination skills have very good metric characteristics, because reliability coefficients are quite high and they range from 0.93 to 0.99. Given the high-quality structures of correlation matrices of items and their projection on the first principal component, it can be stated that all items of each measurement belong to one manifesting common space which indicates that the tests measured what they were intended to measure.

Based on the results obtained in this research, the recommendation is to use the applied tests for the purposes of diagnosing coordination skills in dance, as well as for programming the training process of dancers.

Key words: coordination skills, metric characteristics, dancers.

Uvod

U kineziološkim istraživanjima i njihovoj praksi uobičajena je procedura da se iste varijable mjere uzastopno sa više mjerenja, tzv. čestica (itema). Ovo je potreb-

INTRODUCTION

In the kinesiology research and their practice, it is a common procedure for the same variables to be measured successively by a few measurements, of the so-

no raditi kad god je to moguće, jer iz takvih paralelnih testovnih rezultata proizilazi stvarni rezultat, gdje se uticaj grešaka različitih vrsta smanjuje na najmanju moguću mjeru. Ovo je moguće, jer u ponovljenim mjerenjima u konačnom rezultatu entiteta ostaje samo onaj dio testa koji kod svih ispitanika mjeri samo ono što je zajedničko svim pokušajima mjerenja. Zbog toga se u znatnoj mjeri povećava pouzdanost testa, kao i vjerodostojnost da se mjerilo samo ono što se zaista htjelo mjeriti. Pouzdanost, valjanost, objektivnost i diskriminativnost testa su osnovne metrijske karakteristike, koje mora da ima bilo koji test, da bi bio koristan i primjenjiv (Mijanović i Vojvodić, 2010).

Istraživanja po pitanju definisanja strukture koordinacije započeta su na našim prostorima još 1970-ih godina (Hošek, 1976). Koordinacija je sposobnost upravljanja pokretima cijelog tijela ili dijelova lokomotornog aparata koja se ogleda u brzom i preciznom izvođenju složenih motoričkih zadataka, odnosno u brzom rješavanju motoričkih zadataka (problema). Zbog toga se ona i naziva „motoričkom inteligencijom” (Nićin, 2000). Koordinaciju posmatramo kao sposobnost organizovanja vještog, novog kretanja, sposobnost “prebacivanja” sa jednog kretanja na drugo, sasvim različito, i sposobnost za improvizaciju i kombinaciju u procesu motoričke aktivnosti. Ona je od primarne važnosti za postizanje usavršavanja tehnike i taktike, kao i za njihovu primjenu u novim okolnostima u svim granama sporta. Koordinacija je takođe važna u prostornoj orijentaciji u izvođenju plesnih struktura (skokovi, okreti) ili kada postoji nedostatak ravnoteže (doskok, brzo zaustavljanje). Koordinacija odražava sposobnost brzog izvođenja pokreta različitih stepeni težine s velikom preciznošću i djelotvornošću i u skladu sa specifičnim ciljevima treninga.

Fiziološke osnove koordinacije leže u koordinaciji nervnih procesa centralnog nervnog sistema. Uspješan program za razvoj koordinacije trebalo bi da se uglavnom oslanja na usvajanje velike raznovrsnosti vještina. Koeficijent urođenosti koordinacije iznosi oko 0.80, tako da razvijanje ove sposobnosti treba početi još u ranom djetinjstvu. Malo je situacija u sportu gdje imamo stabilan oslonac i mogućnost korištenja zajedno obje noge ili ruke. Mnogi autori u svojim istraživanjima ukazuju na važnost utvrđivanja postojanja disbalansa lijeve i desne strane. Pokazalo se da sportisti pokazuju različite rezultate u testovima koordinacije posebno, kada je u pitanju kretanje u jednu ili drugu stranu (Njaradi, 2008). Iz ovoga proizilazi potreba za konstrukcijom testova koji bi registrovali valjano, pouzdano ili objektivno reakcije sportista pri izvođenju navedenih i sličnih kretnih struk-

called items. This is necessary to do whenever possible, because these parallel test results produce the actual result, where impact of different types of errors is reduced to the minimum. This is possible, because in repeated measurements in the final result of the entity the only part of the test that remains with all the participants is the one that measures only what is common for all the attempts of measurement. This is why reliability of the test significantly increases, as well as the credibility that only what was really intended to be measured was actually measured. Reliability, validity, objectivity and discriminability of the test are the principal metric characteristics that any test must possess in order to be useful and applicable (Mijanović and Vojvodić, 2010).

Studies with regards to defining coordination structure were started in our region as far back as the 1970s (Hošek, A., 1976). Coordination is an ability to manage movements of the whole body or the locomotor system parts which reflects in swift and accurate execution of complex motor tasks, that is, in prompt resolving of the motor tasks (problems). This is why it is called “the motor intelligence” (Nićin, 2000). We view coordination as the ability to organise skilled, new movement, the ability to “shift” from one movement to another, completely different one, and the ability to improvise and combine in the motor activity process. It is of fundamental importance for achieving perfecting of techniques and tactics, as well as for their administration in new circumstances in all branches of sport. Coordination is also important in spatial orientation while executing dance structures (jumps, turns) or when there is a lack of balance (jump landing, quick stop). Coordination reflects the ability for swift execution of movements of different degrees of difficulty with high accuracy and effectiveness and in accordance with specific objectives of the training.

Physiological fundamentals of coordination lie in coordination of neural processes of the central nervous system. Successful programme for development of coordination should mainly rely on adopting a great diversity of skills. Coefficient of natural coordination is about 0.80, so that development of these skills should begin in early childhood. There are few situations in sports where we have a stable support and possibility to use both feet and hands together. Many authors in their research indicate the importance of determining existence of imbalances between the left and right side. It followed that athletes showed different results in tests of coordination, particularly when it comes to movement towards one side or the other (Njaradi, 2008). This implies the need for creating tests that would register responses of athletes in a valid, reliable or objective manner while they are execut-

tura i pomoću kojih se, uz određena odstupanja može predvidjeti rezultat.

Koordinacija spada u primarne sposobnosti plesača. Koordinacija i ritam sa eksplozivnom snagom i fleksibilnosti su motoričke sposobnosti na koje bi trebalo obratiti pažnju prilikom selekcije djece za ples (Vlašić, Oreb i Furjan-Mandić, 2007). Specifična koordinacija plesača dozvoljava plesačima da brzo, precizno i s lakoćom izvodi kompleksne tehničke strukture u različitim uslovima. Kostić (1996) je utvrdila postojanje značajne korelacije između sposobnosti motoričkog izražavanja ritmičkih struktura i uspješnosti u plesu, a Uzunović (2004) je kod plesačica potvrdio, između ostalog, i uticaj koordinacije i koordinacije u ritmu na uspješnost u sportskom plesu. Uzunović (2008) je utvrdio i pozitivan uticaj modernog sportskog plesa na razvoj koordinacije, brzine i snage. Uzunović, Kostić i Miletić (2009) su u svom istraživanju zaključili da varijable za procjenu koordinacije, brzine frekvencije pokreta, ravnoteže, koordinacije u ritmu i fleksibilnosti, objašnjavaju 66% varijanse uspješnosti u takmičarskim standardnim plesovima kod plesačica. Srhoj, Katić i Kaliterna (2006) ističu dominantni uticaj koordinacije u objašnjenju latentne strukture narodnih plesova. Lukić i Bijelić (2006) su u svom istraživanju o povezanosti koordinacije u ritmu i uspješnosti izvođenja složenih plesnih struktura rumba i džajva konstatovale odsustvo prognostičke valjanosti koordinacije u ritmu na uspješno izvođenje složenih plesnih struktura džajva i statistički značajnu prediktivnu valjanost sposobnosti koordinacije u ritmu na uspješnost izvođenja složenih plesnih struktura rumba. Vlašić, Oreb i Lešić (2009) zaključuju da je povezanost plesne uspješnosti i motoričkog prostora definisana prediktorima: koraci u stranu sa okretom za 360 stepeni (MAGKUS360) – koordinacija, i skok u vis iz mjesta (MFESVM) – eksplozivna snaga.

Specifična manifestacija koordinacije u plesu ogleda se u sposobnosti vladanja prostorom, u usklađivanju pokreta tijela, u sposobnosti visoke adaptacije i reorganizacije kretanja na promjene pravca, nepredviđene i složene uslove koje diktiraju situacije u igri. Koordinacija u plesu se može podijeliti na opštu i specifičnu koordinaciju. Prema tome, koordinacija ima integrativni karakter – objedinjuje i u sebi sadrži sve ostale motoričke osobine. Plesni sadržaji pozitivno utiču na razvoj i poboljšanje koordinacije (Kostić, Miletić, Jocić i Uzunović, 2002; Uzunović, Kostić i Živković, 2010; Cosma, Dragomir, Dumitru, Lica i Ghetu, 2016).

Imajući u vidu značaj koordinacije za uspjeh u plesu i da se sa stimulacijom razvoja iste mora započeti

ing the above and similar movement structures and by which, with certain variations, the result can be predicted.

Coordination falls under the primary skills of dancers. Coordination and rhythm with explosive power and flexibility are the motor skills that needs to be addressed while selecting the children for dancing (Vlašić, Oreb and Furjan-Mandić, 2007). Specific coordination of dancers allows dancers to execute complex technical structures under different conditions swiftly, accurately and with ease. Kostić, R. (1996) found that there was a significant correlation between the abilities of rhythmic structures motor expression and successfulness in dance, and, among other things, Uzunović (2004) also confirmed impact of coordination and coordination in rhythm on successfulness in sport dancing with female dancers. Uzunović (2008) also determined positive impact of modern sport dance on development of coordination, speed and power. Uzunović, Kostić and Miletić (2009) concluded in their research that variables for assessing coordination, movement frequency speed, balance, coordination in rhythm and flexibility, explain 66% of the successfulness variance in competitive standard dances with female dancers. Srhoj, Katić and Kaliterna (2006) emphasize the dominant influence of coordination in explaining latent structure of folk dances. Lukić, A. and Bijelić, S. (2006) noted in their research on correlation of coordination in rhythm and successfulness of executing complex dance structures of rumba and jive, the absence of prognostic validity of coordination in rhythm to successful execution of complex dance structures of jive and statistically significant predictive validity of the coordination in rhythm skill towards successfulness in execution of complex rumba dance structures. Vlašić, Oreb and Lešić (2009) conclude that correlation between dance successfulness and motor space is defined by predictors: side steps with a turn of 360 degrees (MAGKUS360) - coordination, and high jump from the spot (MFESVM) - explosive power.

Specific manifestations of coordination in dance is reflected in ability to manage space, in alignment of body movements, ability of high adaptation and reorganisation of movement to the changes of direction, unforeseen and complex conditions dictated by situations in dancing. Dance coordination can be divided into general and specific coordination. Thus, coordination is of integrative nature - it combines and incorporates all other motor characteristics within itself. Dance activities have a positive impact on development and improvement of coordination (Kostić, Miletić, Jocić and Uzunović, 2002; Uzunović, Kostić and Živković, 2010; Cosma, Dragomir, Dumitru, Lica and Ghetu, 2016).

Given the importance of coordination for successfulness in dance and that its development stimulation

rano, sprovedeno je istraživanje sa ciljem da se utvrde metrijske karakteristike testova za procjenu koordinacionih sposobnosti mlađih juniora (juniora 1) u plesu.

METODE RADA

Uzorak ispitanika

Istraživanjem je obuhvaćeno 36 ispitanika polaznika plesnog kluba „Gemma“ iz Banja Luke, podijeljenih kao 18 plesnih parova (18 dječaka i 18 djevojčica). Obuhvaćeni su ispitanici muškog i ženskog pola uzrasta od 12 do 13 godina koji po kategorizaciji Plesnog saveza Bosne i Hercegovine pripadaju kategoriji mlađih juniora.

Pri izboru ispitanika za ovo istraživanje vodilo se računa o sljedećim elementima:

- da su svi ispitanici uzrasta 12 do 13 godina,
- da su svi ispitanici redovni polaznici Plesnog kluba „Gemma“,
- da ispitanici nemaju zdravstvenih smetnji i izraženih tjelesnih deformacija koji bi mogli uticati na rezultate mjerenja.

Uzorak varijabli

Za procjenu koordinacionih sposobnosti u ovom istraživanju korišteno je ukupno šest testova i to, tri testa za procjenu koordinacije cijelog tijela i tri testa za procjenu koordinacije u ritmu.

Uzorak varijabli za procjenu koordinacije cijelog tijela

1. Koordinacija sa palicom (MKOSPA)
2. Vođenje lopte rukom (MKAVLR)
3. Poligon natraške (MREPOL)

Uzorak varijabli za procjenu koordinacije u ritmu

4. Bubnjanje rukama i nogama (MKRBNR)
5. Neritmično bubnjanje (MKRBUB)
6. Udaranje po horizontalnim pločama (MKRPLH)

METODE OBRADE PODATAKA

U skladu sa ciljem ovog rada urađene su sljedeće procedure:

- a. Izračunati su osnovni statistički parametri varijabli u sva tri mjerenja u okviru kojih su izračunati:
 - Minimalni rezultati mjerenja (Min),
 - Maksimalni rezultati mjerenja (Max),
 - Aritmetičke sredine varijabli za svako od tri

must start early, a research was conducted in order to determine metric characteristics of tests for assessment of coordination skills of young juniors (junior 1) in dance.

WORK METHODS

The participants sample

The research included 36 participants, students of the dance club “Gemma” from Banja Luka, divided as 18 dance couples (18 boys and 18 girls). It included participants of masculine and feminine gender, between 12 and 13 years of age, who fall under the category of young juniors according to the categorisation of the Dance Association of Bosnia and Herzegovina.

While selecting the participants for this research, the following elements were taken into account:

- that all the participants were between 12 and 13 years of age,
- that all the participants were regular students of the dance club „Gemma”,
- that the participants had no health issues and strong physical deformities that could affect the measurements results.

The variables sample

For assessment of coordination skills in this research a total of six tests was used and these were three tests for assessment of coordination of the whole body and three tests for assessment of coordination in rhythm.

The variables sample for assessment of coordination of the whole body

1. Coordination with a bat (MKOSPA)
2. Dribbling a ball with a hand (MKAVLR)
3. The exercising range backwards (MREPOL)

The variables sample for assessment of coordination in rhythm

4. Hands and feet drumming (MKRBNR)
5. Non-rhythmic drumming (MKRBUB)
6. Beating against horizontal plates (MKRPLH)

DATA PROCESSING METHODS

In line with the objective of this paper the following procedures have been carried out:

- a. Basic statistical parameters of variables were calculated in all three measurements within which the following was calculated:
 - Minimum measurement results (Min),
 - Maximum measurement results (Max),

- mjerenja (Mean),
- Standardne devijacije varijabli (Std. dev.),
- Koeficijent zakrivljenosti (Skewness),
- Koeficijent spljoštenosti (Kurtosis).
- b. Izvršena je procjena metrijskih karakteristika primijenjenih varijabli:
 - Procjena korelacije između čestica (matrica korelacija),
 - Procjena prosječne korelacije između čestica (RMS),
 - Spearman – Brown-ova mjera pouzdanosti (S-B),
 - Validnost kao Chronbachov indeks generalizabilnosti (Chr),
 - Pouzdanost na temelju Harisove matrice (λ_6).

REZULTATI I DISKUSIJA

Svi mjerni instrumenti za procjenu koordinacionih sposobnosti ispitanika – plesača mlađih juniora u ovom istraživanju podvrgnuti su postupku analize njihovih metrijskih karakteristika. Testovi za procjenu koordinacionih sposobnosti primijenjenih u ovom istraživanju su višestruki (3-5 mjerenja), te je iz njih generisani rezultat, kompozit dobijen funkcijom iz tih mjerenja. Ta funkcija u suštini predstavlja linearnu kombinaciju (projekcije na prvi glavni predmet mjerenja čestica reskaliranih na anti-image kovarijanse koji dopušta nenulte kovarijanse između varijabli greške) koja se u mnogim dosadašnjim istraživanjima pokazala dosta rezistentna na mnoge uticaje sistematskih i nesistematskih grešaka u mjerenju. Postupak analize metrijskih karakteristika koordinacionih mjernih instrumenata pretpostavljao je dobijanje velike količine podataka, ali su za potrebe ovog istraživanja odabrane samo one koje na jednostavan i razumljiv način daju informacije o kvalitetu mjerenja na nivou čestica.

Pouzdanost je mjerna karakteristika koja ukazuje na to koliko ima pogrešaka u konačnom rezultatu na nekom mjernom instrumentu, a koliko je taj dobijeni rezultat „pravi“ rezultat ispitanika, koji govori o njegovim sposobnostima ili osobinama koje se mjere tim instrumentom. Primijenjenim mjernim instrumentima (testovima) pokušale su se procijeniti koordinacione sposobnosti mlađih juniora u plesu. Mjerenja koja su provedena u tri čestice za svaki mjerni instrument (test) kondenzovane su na konačan rezultat. Kako su primijenjeni mjerni instrumenti kompozitni (višečestični), za utvrđivanje pouzdanosti koristila se metoda interne konzistencije koja se sastoji od utvrđivanja korelacija

- Arithmetic mean of the variables for each of the three measurements (Mean),
- Standard deviations of the variables (Std. Dev.),
- Coefficient of curvature (Skewness),
- Kurtosis.
- b. An assessment of metric characteristics of applied variables was performed:
 - Assessment of correlation among items (correlation matrix),
 - Assessment of average correlation among items (RMS),
 - Spearman - Brown's formula reliability measure (S-B),
 - Validity as Chronbach's index of generalizability (Chr),
 - Reliability based on the Harris matrix (λ_6).

RESULTS AND DISCUSSION

All measuring instruments for assessment of coordination skills of participants - young junior dancers in this research were subjected to the analysis procedure of their metric characteristics. Tests for assessment of coordination skills applied in this research were multifunction (3-5 measurements), and the result generated from them represents a composite obtained from these measurements function. In essence this function is a linear combination (projection on the first principle object of measuring the items rescaled on anti-image covariances which allows nonzero covariances among variables of errors) which has shown to be quite resistant to many influences of systematic and unsystematic measurement errors in many previous studies. The analysis procedure of metric characteristics of coordination measuring instruments assumed obtaining large amounts of data, but for the purposes of this research, the only selected data were the ones providing information on the quality of measurements at the level of items in a simple and understandable way.

Reliability is a measuring characteristic indicating how many errors there are in the final result on a measuring instrument, and how much does this result represent a “true” result for a participant that speaks about their skills or characteristics measured by the instrument. Using the applied measuring instruments (tests) it was attempted to assess coordination skills of young juniors in dance. We summarised the measurements that were carried out in three items for each measuring instrument (test) into the final result. As the applied measuring instruments were composite (multi-item), in order to determine reliability, an internal consistency method comprising of determi-

između čestica mjernih instrumenata. Tabela 1 prikazuje matricu korelacija među česticama primijenjenih mjernih instrumenata (testova).

Tabela 1. Matrica korelacija među česticama primijenjenih mjernih instrumenata (testova), pouzdanost i homogenost

	MKOSPA1	MKOSPA2	MKOSPA3 RMS	S-B	Chr	Lambda 6	HOM
MKOSPA1	1.00	0.82	0.86				
MKOSPA2	0.82	1.00	0.96 0.88	0.98	0.95	0.97	0.98
MKOSPA3	0.86	0.96	1.00				
	MKAVLR1	MKAVLR2	MKAVLR3				
MKAVLR1	1.0000	0.8292	0.8593				
MKAVLR2	0.8292	1.0000	0.9751 0.93	0.99	0.98	0.99	0.98
MKAVLR3	0.8593	0.9751	1.0000				
	MREPOL1	MREPOL2	MREPOL3				
MREPOL1	1.0000	0.8558	0.9095				
MREPOL2	0.8558	1.0000	0.9637 0.93	0.99	0.98	0.99	0.99
MREPOL3	0.9095	0.9637	1.0000				
	MKRBNR1	MKRBNR2	MKRBNR3				
MKRBNR1	1.0000	0.6491	0.8188				
MKRBNR2	0.6491	1.0000	0.9266 0.80	0.97	0.92	0.96	0.93
MKRBNR3	0.8188	0.9266	1.0000				
	MKRBUB1	MKRBUB2	MKRBUB3				
MKRBUB1	1.0000	0.4805	0.5492				
MKRBUB2	0.4805	1.0000	0.9344 0.67	0.95	0.84	0.94	0.95
MKRBUB3	0.5492	0.9344	1.0000				
	MKRPLH1	MKRPLH2	MKRPLH3				
MKRPLH1	1.0000	0.7098	0.8274				
MKRPLH2	0.7098	1.0000	0.9445 0.83	0.97	0.92	0.96	0.95
MKRPLH3	0.8274	0.9445	1.0000				

Legenda: RMS (prosječne korelacije između čestica), S-B (Spearman–Brown-ova mjera pouzdanosti), Chr (validnost kao Chronbachov indeks generalizabilnosti), λ -6 (pouzdanost na temelju Harisove matrice), HOM (homogenost)

Analizom tabele 1. u kojoj je prikazana matrica korelacija među česticama primijenjenih mjernih instrumenata (testova) može se vidjeti da su prosječne korelacije između čestica sasvim zadovoljavajuće. Prosječna korelacija za mjerni instrument (test) MKOSPA iznosi 0.88, za MKAVLR 0.93, za MREPOL 0.93, za MKRBNR 0.80, za MKRBUB 0.67, za MKRPLH 0.83. Na osnovu vrijednosti korelacija među česticama izračunata je Spe-

ning correlations among the measuring instruments items was used. Table 1 shows the matrix of correlations among items of the applied measuring instruments (tests).

Table 1. The matrix of correlations among items of the applied measuring instruments (tests), reliability and homogeneity

Key: RMS (average correlations among items), S-B (Spearman–Brown’s measure of reliability), Chr (validity as Chronbach’s index of generalizability), λ -6 (reliability based on the Harris matrix), HOM (homogeneity)

Through analysis of Table 1 which shows the matrix of correlations among the items of the applied measuring instruments (tests) it can be seen that average correlations among items are quite satisfactory. The average correlation for measuring instrument (test) MKOSPA is 0.88, for MKAVLR 0.93 for MREPOL 0.93 for MKRBNR 0.80 for MKRBUB 0.67, for MKRPLH 0.83. Based on the value of correlations among the items Spearman–Brown

arman-Brownova mjera pouzdanosti (S-B) . S obzirom na visoke korelacije između čestica i veličine S-B mjere pouzdanosti kod primijenjenih mjernih instrumenata, može se konstatovati da su mjerni instrumenti za procjenu koordinacionih sposobnosti pouzdani.

Homogenost mjernog instrumenta bi trebala ukazivati na dvije karakteristike testa: 1) korelacije među česticama – da li su ispitanici postigli iste ili slične rezultate na svim česticama, 2) raspon rezultata na svim česticama trebao bi biti podjednak. Prilikom provjeravanja pouzdanosti, utvrđena je visoka korelacija među česticama mjerenja što je jedan od pokazatelja homogenosti mjernog instrumenta.

Tabela 2. Osnovni deskriptivni parametri čestica testiranja primijenjenih mjernih instrumenata - testova

Varijabla / Variable	Mjerenje / Measurement	Min	Max	Mean	Std. dev.	Skewness	Kurtosis
MKOSPA	1	5.74	15.38	9.18	2.49		
	2	5.18	15.45	7.72	1.98		
	3	5.25	15.44	8.14	2.01	1.0577	4.7550
MKAVLR	1	7.14	15.91	11.20	2.08		
	2	6.69	15.60	10.61	2.27		
	3	7.16	15.72	10.75	2.13	0.3168	2.5032
MREPOL	1	7.20	16.99	11.97	2.24		
	2	6.84	15.93	11.26	2.22		
	3	7.04	16.15	11.63	2.06	0.0890	2.5979
MKRBNR	1	2.00	14.00	8.36	3.21		
	2	2.00	15.00	9.80	3.16		
	3	1.00	14.00	8.83	2.97	-0,6790	3.1138
MKRBUB	1	5.00	19.00	11.36	3.23		
	2	2.00	23.00	12.50	3.53		
	3	3.00	20.00	11.83	3.13	-0,1269	4.2008
MKRPLH	1	2.00	22.00	15.41	5.77		
	2	2.00	22.00	16.72	4.94		
	3	2.00	21.00	15.94	4.83	-1.1650	3.5912

Legenda: Mean - aritmetička sredina, MIN - minimalna vrijednost, MAX - maksimalna vrijednost, Std. Dev.- standardna devijacija, Skewness, Kurtosis)

Podjednak raspon rezultata može se provjeriti u tabeli 2. iz koje se vidi da nema značajnijih odstupanja među česticama mjerenja. Za procjenu homogenosti rezultata provjeren je i stepen izduženosti/spljoštenosti vrha krivulje distribucije rezultata (kurtosis). Prema

reliability measure was calculated (S-B). Given the high correlations among the items and the value of S-B reliability measure with the applied measuring instruments, it can be concluded that the measuring instruments for assessment of coordination skills are reliable.

Homogeneity of the measuring instrument should indicate two characteristics of the test: 1) correlations among the items - whether the participants achieved the same or similar results on all the items, 2) the results range for all the items should be equal. While validating reliability a high correlation among the measurement items was found as an indicator of homogeneity of the measuring instrument.

Table 2. Basic descriptive parameters of the tested items of the applied measuring instruments - tests

Key: Mean - arithmetic mean, MIN - minimum value, MAX - maximum value, Std. Dev.- standard deviation, Skewness, Kurtosis)

Equal range of results can be checked in table 2, which shows that there were no significant differences among the measurements items. In order to assess homogeneity of the results, the elongation/flattening of the peak level of the results distribution curve (kurtosis) was

dobijenim podacima može se vidjeti da je distribucija rezultata na prvom čestici platikurtična, a na druge dvije leptokurtična, što se može objasniti fenomenom motoričkog učenja tokom testiranja. Dakle, uvidom u tabele 1 i 2. može se zaključiti da je homogenost primijenjenih mjernih instrumenata u ovom istraživanju visoka. *Osjetljivost* kao mjerna karakteristika mjernog instrumenta pretpostavlja prepoznavanje i vrlo male razlike među ispitanicima. Provjera normaliteta distribucije rezultata izvršena je putem Kolmogorov – Smirnov testa. Na osnovu rezultata može se zaključiti da dobijena distribucija rezultata ne odstupa značajno od očekivane normalne distribucije. Rezultati ispitanika normalno su distribuirani, a primijenjeni testovi pokazali su zadovoljavajuću osjetljivost. S obzirom na to da je K – S test normaliteta distribucije pokazao da opažene raspodjele ne odstupaju od normalnih, može se konstatovati da su primijenjeni mjerni instrumenti za procjenu koordinacionih sposobnosti osjetljivi.

Imajući u vidu da su sve metrijske karakteristike primijenjenih mjernih instrumenata na zadovoljavajućem nivou, može se konstatovati da su primijenjeni mjerni instrumenti (testovi) primjenljivi u praksi te se preporučuje njihova upotreba za procjenu koordinacionih sposobnosti u trenažnoj praksi sa plesačima oba pola - juniorima, uzrasta 12-13 godina.

ZAKLJUČAK

Na uzorku od 36 ispitanika oba pola, juniorima, uzrasta 12-13 godina, polaznika plesnog kluba „Gemma“ iz Banja Luke, podijeljenih kao 18 plesnih parova (18 dječaka i 18 djevojčica) izvršeno je istraživanje sa ciljem utvrđivanja metrijskih karakteristika testova za procjenu koordinacionih sposobnosti polaznika plesnog kluba „Gemma“ iz Banja Luke. U istraživanju je primijenjeno šest varijabli za procjenu koordinacionih sposobnosti (tri varijable za procjenu koordinacije cijelog tijela i tri varijable za procjenu koordinacije u ritmu).

Analizom vrijednosti osnovnih statističkih parametara vidljivo je da se najveći broj varijabli ponaša očekivano u smislu formiranja normalne distribucije.

Na osnovu izračunatih metrijskih karakteristika mjernih instrumenata (testova) za procjenu koordinacionih sposobnosti može se zaključiti da gotovo svi testovi imaju vrlo dobre metrijske karakteristike, jer su koeficijenti pouzdanosti dosta visoki i kreću se u rasponu od 0.93 do 0.99. Ta činjenica govori o tome da su primijenjene varijable izmjerene dosta pažljivo i kvalitetno. S obzirom na vrlo kvalitetne strukture korelacijskih matrica čestica (itema) i njihove projekcije na prvu glavnu

validated as well. According to the data obtained it can be seen that the distribution of results on the first item is platykurtic, and leptokurtic on the other two, which can be explained by the phenomenon of motor learning during the testing. Thus, by examining the tables 1 and 2 it can be concluded that homogeneity of the applied measuring instruments in this research is high. *Sensitivity* as a measuring characteristic of the measuring instrument assumes recognition and minor differences among the participants. Validating normality of the results distribution was performed by *Kolmogorov - Smirnov* test. Based on the results it can be concluded that the results distribution obtained does not differ significantly from the expected normal distribution. Results of the participants are normally distributed and the applied tests showed satisfactory sensitivity. Given that the K - S test of the distribution normality showed that observed distributions do not differ from the normal ones, it can be concluded that the applied measuring instruments for assessment of coordination skills are sensitive.

Bearing in mind that all metric characteristics of the applied measuring instruments are on a satisfactory level, it can be concluded that the applied measuring instruments (tests) are applicable in practice and their use is recommended for assessment of coordination skills in the training practices for the dancers of both sexes - juniors, between 12 and 13 years of age.

CONCLUSION

In a sample of 36 participants of both sexes, juniors, between 12 and 13 years of age, students of the dance club “Gemma” from Banja Luka, divided as 18 dance couples (18 boys and 18 girls) the research was carried out with the objective to determine metric characteristics of tests for assessment of coordination skills of students of the dance club “Gemma” from Banja Luka. Six variables for assessment of coordination skills were applied in the research (three variables for assessment of coordination of the whole body and three variables for assessment of coordination in rhythm).

Through analysis of the basic statistical parameters values it is evident that the most variables behaved as expected in terms of forming the normal distribution.

Based on the calculated metric characteristics of measuring instruments (tests) for assessment of coordination skills, it can be concluded that almost all the tests have very good metric characteristics, because the reliability coefficients are quite high and they range from 0.93 to 0.99. This fact shows that the applied variables were measured quite carefully and in a high quality

komponentu može se konstatovati da sve čestice (itemi) svakog pojedinog mjerenja pripadaju jednom manifestnom zajedničkom prostoru. Dakle, testovi su mjerili ono što se i željelo mjeriti. Nešto slabije metrijske karakteristike pokazuje varijabla neritmično bubnjanje (MKRBUB), što i ne treba da iznenađuje, jer se radi o veoma osjetljivom mjernom instrumentu koji ispituje osjećaj za ritam i pokazuje znatnu varijabilnost od ispitanika do ispitanika.

Na osnovu dobijenih rezultata u ovom istraživanju preporučuje se korištenje primijenjenih testova kako za potrebe dijagnostikovanja koordinacionih sposobnosti u plesu, tako i za programiranje trenažnog rada plesača juniorima oba pola, uzrasta 12-13 godina.

Izjava autora

Autori pridonijeli jednako.

Konflikt interesa

Mi izjavljujemo da nemamo konflikt interesa.

manner. Given the very high-quality structures of the items correlation matrix and their projections on the first principal component it can be stated that all the items of each measurement belong to one manifesting common space. Thus, the tests did measure what was intended to be measured. Somewhat weaker metric characteristics are shown by the variable of non-rhythmic drumming (MKRBUB), which should not be surprising anyway, because this is a very sensitive measuring instrument that examines the sense of rhythm and shows considerable variability from participant to participant.

Based on the results obtained in this research, it is recommended to use the applied tests for the purposes of diagnosing coordination skills in dance as well as for programming the training process for junior dancers of both sexes, between 12 and 13 years of age.

Authorship statement

The authors have contributed equally.

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We declare that we have no conflicts of interest.

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RAZLIKE U METABOLIČKO-ENERGETSKIM POTENCIJALIMA FUDBALERA KADETSKOG UZRASTA U ODNOSU NA TAKMIČARSKI NIVO

DIFFERENCES IN METABOLIC-ENERGY POTENTIAL IN U16 FOOTBALL PLAYERS (CADET AGE) IN RELATION TO COMPETITION LEVEL

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Apstrakt: Sa ciljem da se utvrdi razlika metaboličko-energetskih potencijala fudbalera kadetskog uzrasta različitih stepena takmičenja, sprovedeno je istraživanje na uzorku od šezdeset fudbalera starosti 14 do 16 godina. Uzorak ispitanika je podeljen na sledeće subuzorke: igrači fudbalske reprezentacije Srbije (n=20), igrači kvalitetne lige Vojvodine (n=21) i igrači područnog ranga takmičenja (n=19). Određivanje koncentracije laktata u krvi vršeno je uzimanjem kapilarne krvi iz prsta u tri faze Kuperovog testa: koncentracija laktata u miru merena je pre početka opterećenja-testa, koncentracija laktata u opterećenju merena je jedan minut po završetku testa i koncentracija laktata u oporavku merena je u desetoj minuti oporavka. Rezultati istraživanja ukazuju na postojanje statistički značajnih razlika navedenih grupa u odnosu na analizirane metaboličko-energetске vrednosti fudbalera.

Ključne reči: fudbaleri, laktati, kadeti, metaboličko-energetski procesi

Abstract: In order to determine the difference in metabolic-energy potential in U16 football players (cadet age) at different levels of competition, a survey was conducted on a sample of sixty players aged 14 to 16. The sample of respondents is divided into the following subsamples: players of Serbian national football team (n=20), players from high-quality league of Vojvodina (n=21) and the players from the regional competition levels (n=19). The lactate blood level was determined by testing capillary blood from the finger during three stages of Cooper test: the concentration of lactate in the standstill stage was measured before the start of the test – before the load; the concentration of lactate during the load stage was measured one minute after completion of the test; and the concentration of lactate in the recovery stage was measured in the tenth minute of recovery. The survey results indicate a statistically significant difference between the said groups of players in relation to the analyzed metabolic-energy parameters of the players.

Keywords: football players, lactates, cadets (U16 age), metabolic-energy processes

Uvod

Fudbal karakteriše kombinacija kratkotrajnih aktivnosti visokog intenziteta i dugotrajnih aktivnosti srednjeg i niskog intenziteta. Tokom utakmice, posmatrajući bioenergetske procese stvaranja energije, organizam fudbalera uključuje sve izvore energije. Od izuzetnog značaja je da organizam fudbalera ne zapadne u energetske krizu. Samo pravilan trenažni rad baziran na formiranim individualnim zonama rada omogućuje maksimalno iskorišćenje energetskih potencijala fudbalera (Higgins i sar. 2009).

Profesionalni fudbaler mora posedovati visok aerobni kapacitet i istovremeno, za fudbal specifičan ana-

INTRODUCTION

The football is characterized by a combination of short-term high-intensity activities and long-term medium and low intensity activities. During the game, regarding the bioenergetic processes of generation of energy, the body of a football player activates all energy sources. It is of utmost importance that the body of the player does not fall into an energy crisis. Only proper training process based on defined individual work zones allows maximum utilization of energy resources of the player (Higgins et al. 2009).

A professional football player must have a high aerobic capacity and at the same time, the football-specific anaerobic capacity (Ekblom, 1986). During the game the

erobni kapacitet (Ekblom, 1986). Tokom utakmice igrač često pređe u različitom tempu trčanja distancu od devet do dvanaest kilometara (Jeffreys, 2008; Burgess i sar., 2006; Mohr i sar., 2003; Bangsbo, 2003; Ohashi i sar., 1988). Snaga, izdržljivost i brzina kao spoljašnje manifestacije energetske-metaboličkih procesa su presudne motoričke sposobnosti u uspešnosti fudbalske igre, ali se ni jedna od njih ne ispoljava samostalno, već u međusobnoj kombinaciji. Ovakav vid sportskog opterećenja je produkt specifične međuzavisnosti koja postoji između metaboličkih i kardiorespiratornih parametara.

Promena nivoa metabolita u krvi, odnosno proces stvaranja i eliminacije iz organizma, u direktnoj je zavisnosti od trajanja rada, intenziteta, i stanja treniranosti fudbalera. Sistematskim praćenjem promena laktata u krvi tokom različitih opterećenja mogu se precizno formirati zone rada i dobiti pouzdani podaci o stanju treniranosti sportiste.

Glavni cilj ovog istraživanja je utvrđivanje razlika između fudbalera različitih nivoa takmičenja u odnosu na stepen adaptacije na laktate, kao i na brzinu eliminacije istih iz organizma, odnosno određivanje vremena oporavka sportiste.

METOD RADA

Uzorak ispitanika

Uzorak ispitanika u istraživanju obuhvata dečake starosti od 14 do 16 godina. Po fudbalskoj kategorizaciji ovaj uzrast spada u kadete. Prvi subuzorak čini dvadeset selektovanih igrača fudbalske reprezentacije Srbije. Drugi subuzorak čini dvadeset i jedan igrač F.K. „Spartak“ iz Subotice koji se takmiče u okviru kvalitetne lige Vojvodine. Treći subuzorak čini devetnaest fudbalera F.K. „Bačka“ iz Subotice i F.K. „Radnički“ iz Bajmoka koji se takmiče u područnom rangu. Kriterijum za izbor ispitanika pored hronološke starosti je: da je ispitanik osoba muškog pola; da je zdravstveno sposobna za bavljenje sportom-fudbalom i da je bez ikakvih morfoloških i motoričkih aberacija.

Postupci istraživanja

Za potrebe istraživanja primenjen je Kuperov test, koji predstavlja najpoznatiji terenski test za indirektno određivanje VO_{2max} . Test je odrađen na atletskoj stazi dugoj 400 m, i obeleženoj na svakih 50 i 10 metara, radi lakšeg očitavanja rezultata. Zadatak fudbalera je bio da pređe što dužu deonicu trčanjem za 12 minuta. Pre početka testa sprovedeno je zagrevanje u trajanju od 15 minuta. Jednu grupu činilo je osam ispitanika,

player often goes a running distance of nine to twelve kilometers with a different running pace (Jeffreys, 2008; Burgess et al., 2006; Mohr et al., 2003; Bangsbo, 2003; Ohashi et al., 1988). Strength, endurance and speed as the external manifestation of the energy-metabolic processes represent essential motor skills for the success during the football game, but none of them manifests itself individually, but in combination with each other. This kind of sport load is the product of the specific interdependence that exists between the metabolic and cardiorespiratory parameters.

Changes in levels of metabolites in the blood, i.e. the process of their creation and elimination from the body, is directly depending on the duration of training, intensity and fitness status of a player. Systematic monitoring of changes in lactate levels at different loads can be used for precise definition of zones of work and obtaining reliable data on the state of fitness of the athlete.

The main objective of this research is to determine the differences between the players from different levels of competition in relation to the degree of adaptation to lactates, as well as to the rate of elimination of the same from the body, i.e. to determine the time needed by athlete to recover.

METHOD

The sample of respondents

The sample in the study includes boys aged 14 to 16. According to the football classification this age group is categorized as cadets (U16 age). The first sub-sample is made of twenty selected players of the national football team of Serbia. The second subsample comprises twenty-one players of the FC “Spartak” from Subotica who compete within the high-quality league of Vojvodina. The third subsample included nineteen players of FC “Bačka” from Subotica and FC “Radnički” from Bajmok who compete in the regional level of competition. In addition to chronological age, criteria for the selection of respondents were: the respondents were males; the respondents were medically fit for engaging in sports-football and the respondents had no morphological and motor abnormalities.

Research methods

For the purpose of this research Cooper test was applied, which is the most known field test for the indirect determination of VO_{2max} . The test was conducted on the 400 m long track, marked at every 50 and 10 meters, for easy reading of the results. The players were asked to cross as long as possible distance by running 12 minutes. Before starting the test a 15 minutes warm-up was conducted. One group consisted of eight respondents, the start was individual, and the time difference

start je bio pojedinačan, a razlika između starta dva ispitanika iznosila je 1 min. Nakon testa ispitanik je nastavljao hodom do zapisničkog stola da bi se izvršilo merenje laktata. Za određivanje laktata u krvi korišćen je elektronski laktat analizator marke "Accusport" firme Boehringer Mannheim. Aparat registruje vrednosti laktata u opsegu od 0,7 mmol/l do 27 mmol/l, a vreme potrebno za merenje iznosi oko 60 sekundi. Metabolička merenja obavljana su u prepodnevnom časovima, u terenskim uslovima i svi fudbaleri su bili upoznati sa procedurom merenja. Određivanje koncentracije laktata u krvi vršeno je uzimanjem uzoraka kapilarne krvi sportista iz prsta. Ispitanik je prilikom merenja bio u sedećem položaju sa podignutom rukom iznad nivoa srca, a sa ciljem smanjenja venske primese koja je u jagodici prsta i inače jače izražena. Pre početka merenja na jagodicu prsta utrljana je mala količina finalgon masti da bi se osigurala hiperemija i sprečila koagulacija krvi. Za uzorak se uzimala krupna kap krvi koja se nanosila na reagentnu traku u tri faze testiranja.

Uzorak varijabli

Za procenu metaboličko-energetskih potencijala fudbalera u ovom istraživanju primenjene su sledeće varijable: koncentracija laktata u miru (mmol/l) - merena je pre početka opterećenja, odnosno Cooper-ovog testa, koncentracija laktata u opterećenju - merena je 1 minut po završetku opterećenja i koncentracija laktata u oporavku - merena je u desetoj minuti oporavka. Celu proceduru merenja vršio je isti merilac, istim instrumentom i istom tehnikom merenja.

Statistička analiza

Za analizu osnovnih statističkih podataka i distribucije rezultata u ovom radu su prikazani: srednja vrednost, standardna devijacija, minimum i maksimum svih vrednosti, koeficijent varijacije, interval poverenja, mere asimetrije Skjunis, mere spoljoštenosti Kurtozis i vrednost testa Kolmogorov-Smirnov. Za utvrđivanje razlika između grupa primenjeni su multivarijantni postupci MANOVA i diskriminativna analiza. Od univarijantnih postupaka primenjeni su ANOVA i t-test za male nezavisne uzorke. Izračunavanjem koeficijenta diskriminacije izdvajaju se obeležja koja određuju specifičnost subuzoraka i obeležja koje je potrebno isključiti iz dalje obrade, odnosno vrši se redukcija posmatranog prostora.

REZULTATI I RASPRAVA

Procena metaboličko-energetskih potencijala urađena je na osnovu merenja nivoa laktata u tri faze testiranja

between the start of two successive respondents was 1 min. After the test, respondents were asked to keep walking to the scorer's table for measurement of lactate blood level. Electronic lactate analyzer of brand "Accusport" produced by the company Boehringer Mannheim was used to determine the lactate blood level. The apparatus registers lactate values in the range from 0.7 mmol/l to 27 mmol/l, and the time required for measurement is around 60 seconds. Metabolic measurements were performed in the morning, on field and all the players were familiar with the measurement procedure. Determination of the lactate blood level was carried out by sampling capillary blood from the finger of these athletes. Respondents were seated during measurement with their arms raised above heart level, in order to reduce venous admixture which is normally more pronounced at the tips of the fingers. Before the measurement a small amount of finalgon ointment was rubbed on player's finger to ensure hyperemia and prevent blood coagulation. A large drop of blood was taken for a sample, and then applied on reagent-grade strip in three phases of testing.

The sample of variables

To assess metabolic-energy potential in football players in this study, the following variables were used: the concentration of lactate in standstill position (mmol/l) - measured before the physical load, i.e. Cooper test, the concentration of lactate during the physical load - measured 1 minute after the end of the test and the concentration of lactate during the recovery - measured in the tenth minute of recovery. The entire measurement procedure was performed by the same measurer, with the same instrument and the same technique of measurement.

Statistical analysis

For the analysis of basic statistics and distribution of results in this paper the following parameters are shown: the mean, standard deviation, minimum and maximum of all values, the coefficient of variation, confidence intervals, skewness as measure of asymmetry, kurtosis as measure of tailedness and the value of Kolmogorov-Smirnov test. To determine differences between groups, multivariate methods MANOVA and discriminant analysis were applied. Regarding univariate methods, ANOVA and t-test for small independent samples were applied. By calculating the coefficient of discrimination we were able to determine the characteristics that describe the specificity of the subsamples and characteristics that need to be excluded from further processing, that is performed by reduction of the observed area.

RESULTS AND DISCUSSION

Assessment of the metabolic-energy potential was performed on the basis of measuring the level of lactate in

nja. Pre početka Kuperovog testa mereni su laktati u miru (LAKTMI), neposredno po završetku testa, odnosno u prvom minutu oporavka mereni su laktati u opterećenju (LAKOPT) i na kraju u desetom minutu mereni su laktati u oporavku (LAKOPO).

three stages of testing. Lactates levels were measured before the start of the Cooper test, in standstill position (LAKTMI), under load immediately after the completion of the test, i.e. in the first minute of the recovery (LAKOPT) and finally in the tenth minute of the recovery (LAKOPO).

Tabela 1. Osnovni statistički parametri metaboličko-energetskih potencijala fudbalera u odnosu na stepen takmičenja

Table 1. Basic statistical parameters of metabolic-energy potential in football players in relation to the level of competition

igrači reprezentacije / National team players

	Mean	St. dev	Min	Max.	C. Var.	Interval	Sk	Ku	K-S	
LAKTMI	2.56	.69	1.4	4.3	27.07	2.23	2.88	.60	.09	.787
LAKOPT	12.33	1.59	10.0	15.5	12.87	11.59	13.07	.49	-.67	.873
LAKOPO	8.47	2.25	4.8	12.6	26.58	7.41	9.52	.24	-1.07	.892

igrači kvalitetne lige Vojvodine / players from high-quality league of Vojvodina

LAKTMI	2.11	.79	1.2	3.9	37.67	1.74	2.47	.74	-.44	.586
LAKOPT	12.29	2.71	5.7	16.6	22.05	11.05	13.52	-.53	-.00	1.000
LAKOPO	9.64	2.83	6.0	16.1	29.34	8.35	10.93	.70	-.58	.330

igrači područnog ranga / players from regional competition level

LAKTMI	2.34	.51	1.4	3.1	21.88	2.10	2.59	-.19	-1.08	.651
LAKOPT	10.81	3.27	3.0	16.2	30.26	9.23	12.39	-.54	.14	1.000
LAKOPO	8.32	2.73	3.1	11.8	32.81	7.00	9.63	-.66	-.89	.983

Legenda: Mean- aritmetička sredina; St.dev.-standardna devijacija; Min.-minimalni rezultat; Max.-maksimalni rezultat; C.Var.-koeficijent varijacije; Interval- interval poverenja; Sk.-simetričnost krive raspodele rezultata; Ku.-spljoštenost krive raspodele rezultata; K-S –Kolmogorov-Smirnov test normalnosti krivulje distribucije.

Legend: Mean- arithmetic mean; St.dev.-standard deviation; Min.-minimum result; Max.-maximum result; C.Var.-coefficient of variation; Interval- confidence interval; Sk.-symmetry of the results distribution curve; Ku.-flatness (tailedness) of the results distribution curve; K-S –Kolmogorov-Smirnov test of distribution curve normality.

Pregledom varijacione širine u svim posmatranim varijablama (tabela 1) može se konstatovati da se rezultati tj. vrednosti nalaze u očekivanom rasponu, kao i da se distribucija vrednosti kreće u okviru normalne raspodele (K-S). Međutim, izrazito odstupanje od srednjih vrednosti, na šta ukazuje koeficijent varijacije, postoji kod svih varijabli, izuzev laktata u opterećenju (12,87 mmol/l) kod igrača reprezentacije. Ove vrednosti navode na činjenicu da su grupe prilično heterogene u odnosu na analizirane metaboličko-energetske vrednosti fudbalera. Vrednosti skjunisa (sk) ukazuju na to da nema izražene asimetrije, pa se može konstatovati da se nalaze u granicama dozvoljenih odstupanja. Negativne vrednosti kurtozisa (ku) ukazuju na to da je kriva spljoštena i da je prisutna veća rasplinutost rezultata kod igrača reprezentacije, za vrednost laktata u oporavku (LAKOPO) i kod igrača područnog ranga, za vrednost laktata u miru (LAKTMI). Srednje vrednosti laktata merenih u miru se kreću u opsegu od 2,11 do 2,56 mmol/l, laktata u

By examining the variation width in all observed variables (Table 1) it can be concluded that the results, i.e. values, fall within the expected range, and that the distribution of values is within the normal distribution ranges (K-S). However, a marked deviation from the mean values, as indicated by the coefficient of variation, is observed in all variables, except for lactates level under load (12.87 mmol/l) in the national team players. These values indicate the fact that the groups were quite heterogeneous with respect to the analyzed metabolic-energy values in football players. Skewness values (sk) indicate that there is no marked asymmetry, so it can be concluded that they are within the permissible tolerances. Negative values of kurtosis (ku) indicate that the curve is flattened and that there is a greater lengthiness of results in national team players regarding the level of lactates in the recovery stage (LAKOPO), and regional competition level players regarding the level of lactates in standstill position (LAKTMI). Mean values of lactates

opterećenju od 10,81 do 12,33 mmol/l i laktata u oporavku od 8,32 do 9,64 mmol/l. Navedene srednje vrednosti ukazuju na to da je razlika najmanja kod laktata merenih u miru i da je verovatno statistički neznajna, dok se u druge dve vrednosti mogu očekivati značajne razlike. Takođe, razlika između vrednosti laktata izmerene neposredno posle opterećenja i u desetom minutu oporavka je najveća kod igrača reprezentacije i iznosi 3,86 mmol/l.

Smatra se (Sudarov i sar., 2000.) da su vrednosti rane faze oporavka dobre ako u desetom minutu nakon opterećenja dobijene vrednosti laktata budu za 1,5 do 2,0 mmol/l manje od vrednosti izmerenih neposredno posle testa (maksimalna vrednost). Takođe, visoka koncentracija laktata uz brzu ranu fazu oporavka, ukazuje na to da fudbaler dobro podnosi opterećenje visokog intenziteta.

Rezultati multivarijantne analize varijanse ($p = .066$) i diskriminativne analize ($p = .075$), prikazane u tabeli 2, ukazuju na postojanje statistički značajne razlike grupa podeljenih prema stepenu takmičenja u odnosu na analizirane metaboličko-energetske vrednosti fudbalera.

Tabela 2. Značajnost razlike metaboličko-energetskih potencijala fudbalera u odnosu na stepen takmičenja

	n	F	P
MANOVA	3	2.046	.066
Discr. Analysis	3	1.977	.075

Legenda: n-broj varijabli, F- vrednost F-testa za testiranje značajnosti razlika aritmetičkih sredina; p- koeficijent značajnosti razlika aritmetičkih sredina; Discr. Analysis -diskriminativna analiza.

Analiza koeficijenta diskriminacije (tabela 3), ukazuje na to da su najveći uticaj diskriminaciji između različitih stepena takmičenja fudbalera u odnosu na procenu metaboličko-energetskih potencijala imali laktati u opterećenju (LAKOPT .096), dok je razlika manja kod laktata u oporavku (LAKOPO .067) i laktata u miru (LAKTMI .055). Univarijantnom metodom ($p > .1$) nije uočena značajna razlika grupa u posmatranim vrednostima.

measured in standstill position range from 2.11 to 2.56 mmol/l, under the load from 10.81 to 12.33 mmol/l, and during the recovery from 8.32 to 9.64 mmol/l. Mentioned mean values indicate that the difference is smallest for lactates measured in standstill position and they are probably statistically insignificant, while for other two values significant differences are expected. Also, the difference between the lactate levels measured immediately after the load, and in the tenth minute of recovery is greatest in the national team players and amounts 3.86 mmol/l.

It is believed (Sudarov et al., 2000) that the values in the early stage of recovery are good if in the tenth minute after the load lactate values are 1.5 to 2.0 mmol/l less than the values measured directly after the test (maximum value). Also, high concentrations of lactate, followed by fast early phase of recovery, indicate that the player tolerates high intensity load very well.

The results of multivariate analysis of variance ($p = .066$) and discriminant analysis ($p = .075$), shown in Table 2, indicate the existence of statistically significant differences between the groups divided according to the level of competition in relation to the analyzed metabolic-energy values in football players.

Table 2. Significance of differences between metabolic-energy potential in football players in relation to the level of competition

Legend: n-number of variables, F- values of F-test used for testing the significance of differences between arithmetic means; p- coefficient of significance of differences between arithmetic means; Discriminative analysis - discriminant analysis.

The analysis of the coefficient of discrimination (Table 3) indicates that the greatest impact on discrimination between different levels of competition of football players in relation to the assessment of metabolic-energy potential, was exerted by lactates under load (LAKOPT .096), while the difference is smaller for lactates during the recovery (LAKOPO .067) and lactates in standstill position (LAKTMI .055). Univariante method ($p > .1$) did not reveal any significant differences between the groups for observed values.

Tabela 3. Značajnost razlike i koeficijent diskriminacije po pojedinim obeležjima metaboličko-energetskih potencijala fudbalera u odnosu na stepen takmičenja

ANOVA	F	P
LAKTMI	2.247	.115
LAKOPT	2.143	.127
LAKOPO	1.575	.216

Legenda: F- vrednost F-testa za testiranje značajnosti razlika aritmetičkih sredina; p- koeficijent značajnosti razlika aritmetičkih sredina; K.dis.- koeficijent diskriminacije.

Na osnovu dosadašnjih razmatranja, analizom homogenosti, mogu se izvesti karakteristike svake grupe i broj unutar grupe. Doprinos karakteristikama fudbalera unutar grupa određen je stepenom diskriminacije, počev od najveće razlike: laktati u opterećenju, laktati u oporavku i laktati u miru.

Tabela 4. Homogenost fudbalera različitog stepena takmičenja u odnosu na procenu metaboličko-energetskih potencijala

	m/n	%
igrači reprezentacije / national team players	13/20	65.00
igrači kvalitetne lige Vojvodine / players from high-quality league of Vojvodina	14/21	66.67
igrači područnog ranga / players from regional competition level	10/19	52.63

Legenda: m-broj igrača koji poseduje karakteristike grupe; n- broj igrača u grupi; %- procenat igrača koji poseduje karakteristike grupe.

Definisane karakteristike igrača reprezentacije ima 13 od 20 fudbalera, homogenost je 65.0% (veća), što znači da 7 fudbalera ima druge karakteristike, a ne karakteristike svoje grupe. Definisane karakteristike igrača kvalitetne lige Vojvodine ima 14 od 21 fudbalera, homogenost je 66.7% (veća) jer 7 fudbalera ima druge karakteristike. Definisane karakteristike igrača područnog ranga ima 10 od 19 fudbalera, homogenost je 52.6% (manja) jer 9 fudbalera ima druge karakteristike (tabela 4).

Veća homogenost prve dve grupe verovatno je posledica bolje selekcije, za razliku od najnižeg stepena igrača gde selekcija ne postoji i gde za ekipu igraju sva deca koja treniraju u klubu. Na kraju potrebno je napomenuti da su veće vrednosti koncentracije laktata dobijene u ovom istraživanju posledica maksimalnog opterećenja na testu. Tokom utakmice, igrači gotovo nikada ne dolaze u stanje totalne iscrpljenosti što rezultira nižim vrednostima laktata. Potvrdu ovim vrednostima daje istraživanje na devet danskih fudbalera (Krustrup i sar.,

Table 3. Significance of differences and the coefficient of discrimination by individual features of metabolic-energy potential in football players in relation to the level of competition

	K. dis.
LAKOPT	.096
LAKOPO	.067
LAKTMI	.055

Legend: F- values of F-test used for testing the significance of differences between arithmetic means; p- coefficient of significance of differences between arithmetic means; K.dis.- coefficient of discrimination.

Based on the previous considerations, by using the analysis of homogeneity, characteristics of each group and the number within the group can be derived. Contribution to the characteristics of football players within the groups is determined by the level of discrimination, starting with the biggest difference: lactates under load, lactates during recovery and lactates in standstill position.

Table 4. Homogeneity of football players from different levels of competition in relation to the assessment of metabolic-energy potential

	m/n	%
igrači reprezentacije / national team players	13/20	65.00
igrači kvalitetne lige Vojvodine / players from high-quality league of Vojvodina	14/21	66.67
igrači područnog ranga / players from regional competition level	10/19	52.63

Legend: m- number of players who possess the characteristics of the group; n- number of players in the group; %- percentage of players who possess the characteristics of the group.

Defined characteristics of a national team player were observed in 13 out of 20 players, homogeneity is 65.0% (higher), which means that seven players have other characteristics, and not characteristics of their group. Defined characteristics of players from high-quality league of Vojvodina were observed in 14 out of 21 players, homogeneity is 66.7% (higher) as 7 players have other characteristics. Defined characteristics of players from the regional competition level were observed in 10 out of 19 players, homogeneity is 52.6% (lower) because 9 players have other characteristics (Table 4).

Greater homogeneity of the first two groups is probably due to better selection, as opposed to the lowest level of competition where there is no player selection and where all children who train at the club also play for the club. Finally, it should be noted that the higher values of blood lactate concentration obtained in this study are the result of the maximum load during the test. During the game, the players almost never come into a state of total exhaustion

2006) kojima je uzorak krvi uziman tokom odigravanja prijateljskog meča: pre utakmice, posle 5, 15 i 45 min. svakog poluvremena, 15 min. posle utakmice i u mirovanju. Tokom mirovanja vrednosti laktata su bile $0,9 \pm 0,2$ mmol, posle 5 min. igre $6,7 \pm 0,9$ mmol, posle 15 min. prvog perioda $7,9 \pm 0,7$ i nakon prvog i drugog poluvremena $6,0 \pm 0,4$ i $5,0 \pm 0,4$ mmol. Reilly (1997) u svojim istraživanjima dobija širi raspon vrednosti, i tvrdi da vrhunski fudbaleri tokom igre imaju od 150 do 200 kratkih intenzivnih akcija, tokom kojih se vrednosti laktata kreću u opsegu od 2 do 14 mmol/l, što ukazuje na to da je u velikom procentu utakmice prisutno obnavljanje energije u anaerobnim uslovima.

ZAKLJUČAK

Vrednosti laktata selektovanih igrača reprezentacije merene neposredno posle opterećenja ukazuju na to da oni imaju najveću vrednost koja iznosi 12,33 mmol/l. Naveden rezultat upućuje na konstataciju da igrači reprezentacije imaju veću toleranciju na laktate i da mogu da podnesu veće koncentracije istih u organizmu. Igrači područnog ranga imaju najmanju vrednost laktata merenih u oporavku (8,32 mmol/l), za razliku od igrača kvalitetne lige (9,64 mmol/l) i igrača reprezentacije (8,47 mmol/l). Međutim, iako igrači reprezentacije nemaju najmanju vrednost laktata u oporavku, imaju najveću razliku između laktata merenih neposredno po završetku testa i u desetom minutu oporavka (rana faza oporavka). Navedena razlika kod igrača reprezentacije iznosi 3,86 mmol/l, kod igrača kvalitetne lige 2,65 mmol/l i kod igrača područnog ranga 2,49 mmol/l.

Vrednosti laktata igrača reprezentacije ukazuju na njihovu sposobnost za opterećenje u formi brzinsko sprinterske i brzinsko distancione izdržljivosti koja je u najvećoj meri prisutna u fudbalskoj igri.

Rezultati ovog istraživanja ukazuju na značaj anaerobnog laktatnog procesa stvaranja energije u uspešnosti fudbalske igre posmatran kroz različit takmičarski nivo. Igrač tokom utakmice veliki deo igre provodi u režimu preko 4 mmol/l, odnosno u anaerobnim uslovima obezbeđuje energiju potrebnu za rad.

Izjava autora

Autori pridonijeli jednako.

Konflikt interesa

Mi izjavljujemo da nemamo konflikt interesa.

resulting in lower values of lactates. Confirmation of these values gives the research on nine Danish players (Krustrup et al., 2006) where a blood sample was taken during the friendly match: before the game, after 5, 15 and 45 min. during each half, 15 min. after the game and in standstill position. During the standstill position the values of lactate levels were 0.9 ± 0.2 mmol, after 5 min. of the game 6.7 ± 0.9 mmol, after 15 min. of the first period 7.9 ± 0.7 and after the first and second half of 6.0 ± 0.4 and 5.0 ± 0.4 mmol. Reilly (1997) in his research gains a wider range of values, and claims that top players during the game have from 150 to 200 short intensive actions, during which the lactate values range from 2 to 14 mmol/l, which indicates that during the great part of the game there is a process of energy recovery in anaerobic conditions.

CONCLUSION

The values of lactates in selected national team players measured immediately after the load point to the fact that they have the highest value, which amounts to 12.33 mmol/l. This result indicates the conclusion that national team players have a higher tolerance to lactate, and can tolerate a higher concentration of the same in the body. Players from the regional competition level have the lowest level of lactate measured during the recovery (8.32 mmol/l), unlike high-quality league players (9.64 mmol/l) and the national team players (8.47 mmol/l). However, although the national team players have the least amount of lactates during the recovery, they also exert the greatest difference between the lactates level measured immediately after the test and in the tenth minute of recovery (early recovery phase). The said difference in national team players amounts to 3.86 mmol/l, in high-quality league players 2.65 mmol/l, and in regional competition level players 2.49 mmol/l.

The values of lactate in national team players indicate that they are able to engage in high-load activities in the form of speed-sprint and speed-distance endurance which are largely present in a football game.

The results of this study indicate the importance of anaerobic lactate process of creating energy in the performance of the football game at different competitive levels. During the game the player spends a big part of it with lactate levels higher than 4 mmol/l, which means that the player generates energy in anaerobic conditions.

Authorship statement

The authors have contributed equally.

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USPOREDBA MAKSIMALNOG PRIMITKA KISIKA (VO₂MAX) DJEVOJČICA DOBI 10 I 14 GODINA

COMPARISON OF MAXIMUM OXYGEN INTAKE (VO₂MAX) IN TEN AND FOURTEEN-YEAR-OLD GIRLS

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Apstrakt: Cilj istraživanja bio je utvrditi da li djevojčice u dobi od četrnaest godina imaju više vrijednosti aerobnog kapaciteta od djevojčica u dobi od deset godina. U istraživanju se željelo utvrditi da li se porastom dobi smanjuje razina kardiorespiratornog fitnesa kod djevojčica te da li se smanjuje ukupna tjelesna aktivnost. Niska razina kardiorespiratornog fitnesa očituje se u mnogim istraživanjima već od rane mladosti, a u velikoj je korelaciji sa sedentarnim načinom života. U istraživanju je sudjelovalo 94 djevojčica od četvrtog razreda do osmog razreda osnovne škole. Uzorak varijabli činile su antropometrijske mjere: tjelesna visina, tjelesna težina, opseg struka, opseg bokova. Sve mjere provedene su prema International Biological Program (IBP). Za procjenu postotaka masti u organizmu (BF%) korišten je i instrument Omron (Tip BF511, Japan). Aerobni kapacitet dobiven je višestupnjaskim testom trčanja od 20 metara- Shuttle run testom. Razina tjelesne aktivnosti procijenjena je PAQ-C upitnikom. Vidljivo je da samo 5% učenica zadovoljava preporuke o bavljenju tjelesnom aktivnošću dok se njih 83% bave umjerenom tjelesnom aktivnošću. Statistički značajna razlika pojavila se kod varijable kojom se procjenjivao aerobni kapacitet gdje je utvrđeno da djevojčice u dobi od deset godina ($p=0,00$) imaju bolji aerobni kapacitet od četrnaestogodišnjih djevojčica. Također, djevojčice u dobi od deset godina značajno više vremena provode u tjelesnoj aktivnosti ($p=0,00$). Rezultati korelacije između aerobnog kapaciteta (VO₂max) i ukupne tjelesne aktivnosti (PA) pokazuju značajnu pozitivnu povezanost ($r = 0,42$; $p = 0,00$). Djevojčice koje ne provode tjelesnu aktivnost u preporučenom vremenu od minimalno 60 minuta imaju potrebu da se usmjeravaju u različite oblike zdravog načina života s posebnim naglaskom na svakodnevno tjelesno vježbanje koje bi trebalo da utječe na povećanje njihovog aerobnog kapaciteta.

Ključne riječi: kardiorespiratorni fitnes, tjelesna aktivnost, VO₂max, tjelesna aktivnost, djevojčice.

Abstract: The objective of the present research was to determine whether aerobic capacity of fourteen-year-old girls is higher than that of ten-year-old girls. The research aimed to establish if the level of cardio respiratory fitness in girls decreases with age, and if their overall physical activity also decreases. A low level of cardio respiratory fitness from an early age has been confirmed in a number of studies, and it has been highly correlated with a sedentary lifestyle. Research participants were 94 fourth and eighth grade primary school girls. The variables were anthropometric measures for body height, body weight, waist circumference, and hips circumference. All the measurements were done in accordance with the International Biological Program (IBP). Body fat percentage (BF%) was also measured with the Omron (Type BF511, Japan). A multistage 20m shuttle run test was used to obtain the values for aerobic capacity, and PAQ-C questionnaire was used to estimate the level of physical activity. The results indicate that only 5% of female students meet the recommendations for physical activity while 83% engage in moderate physical activity. Statistically significant differences were determined for the variables used to estimate the aerobic capacity, with ten-year-old girls ($p=0.00$) having better aerobic capacity than the fourteen-year-old girls. Furthermore, ten-year-old girls were found to be significantly more physically active ($p=0.00$). The results of the correlation test between the aerobic capacity (VO₂ max) and the overall physical activity (PA) indicate significant positive correlation ($r = 0.42$; $p = 0.00$). Girls who do not engage in physical activity at least for the recommended 60 minutes need to be directed towards various forms of healthy lifestyle with a special emphasis on everyday physical exercise that may increase their aerobic capacity.

Keywords: cardio respiratory fitness, physical activity, VO₂ max, physical exercise, girls

UVOD

Aerobni kapacitet (VO² max) odnosi se na intenzitet aerobnog postupka te ukazuje na maksimalnu sposobnost za prijenos i iskoristivosti kisika tijekom vježbanja koje se obavlja uz povećanje intenziteta (Shete, Bute i Deshmukh 2014). Aerobni kapacitet, također naziva se i kardiorespiratorni ili kardiovaskularni fitness, te se smatra da je jedna od najvažnijih dimenzija povezanih sa zdravstvenim fitnessom (Welk GJ, Laurson KR, Eisenmann JC, Cureton KJ., 2011). Aerobni kapacitet (aerobna izdržljivost, kardiorespiratorna izdržljivost ili aerobni fitness) definira se kao sposobnost obavljanja rada kroz duži vremenski period u uvjetima aerobnog metabolizma. Prihvaćeni parametri za procjenu aerobnoga kapaciteta je maksimalni primitak kisika (VO²max), a označava količinu kisika koju organizam može potrošiti u vremenu od jedne minute (Vučetić, V., Šentija, D., 2005). Aerobni kapacitet (VO² max) je “maksimalna količina kisika koje ljudsko tijelo može iskoristiti po minuti aktivnosti ili fizičkog rada” (Dhara & Chatterjee, 2015, str. 9). Aerobni kapacitet je zajedno s krvnim tlakom i otkucajima srca jedan od ključnih markera u procjeni kardiorespiratornog fitnessa (Magutah, 2013., Grant, Corbett, Amjad, Wilson & Aitchison, 1995) koja procjenjuje kardiorespiratornu izdržljivost pojedinca (Dhara & Chatterjee, 2015)

Dosadašnja istraživanja pokazala su da ispitanici sa prekomjernom tjelesnom masom imaju lošije rezultate u kardiorespiratornim testovima od ispitanika sa normalnom tjelesnom masom, te je dokazana niska do umjereno visoka obrnuta korelacija između kardiorespiratornog fitnessa i debljine (Winsley i sur., 2006; Ara i sur., 2007). Niska razina kardiorespiratornog fitnessa i pretilosti u adolescenciji, povezana je s većim rizikom od smrtnosti u odrasloj dobi (Apor, 2011). Činjenice govore da je kardiorespiratorni fitness samostalna determinanta zdravog načina života (Ferreira, Twisk, van Mechelen, Kemper & Stehouwer, 2005). Viša vrijednost aerobnog kapaciteta u djetinjstvu i adolescenciji snažno je povezana sa trenutačnom razinom zdravlja, ali i sa velikom predikcijom u budućnosti (Ruiz et al., 2007, Ortega i sur., 2011).

Aktivan stil života, uključuje i provođenje tjelesne aktivnosti na preporučenim razinama ili uključenosti u organizirano provođenje tjelesne aktivnosti, od temeljne je važnosti za njihovu promociju, a povezana je sa zdravljem među mladima. Izbjegavanje sedentarnog načina života čak i u vrijeme vikenda, može spriječiti nisku razinu kardiorespiratornog fitnessa, osobito kod djevojčica (Barbosa Filho VC, Lopes Ada S, Bozza R, Rech CR, de Campos W. 2014).

INTRODUCTION

The aerobic capacity (VO₂max) refers to the intensity of the aerobic process and indicates the maximum capability for transfer and **usability** of oxygen during exercise with increasing intensity (Shete, Bute, & Deshmukh, 2014). Aerobic capacity, also called cardio respiratory or cardiovascular fitness, is considered to be one of the most important dimensions in connection to health-related fitness (Welk, Laurson, Eisenmann, & Cureton, 2011). The aerobic capacity (aerobic endurance, cardio respiratory endurance or aerobic fitness) can be defined as the ability to perform an activity over a longer period of time under conditions of aerobic metabolism. The accepted parameter for assessing the aerobic capacity is the maximum oxygen intake (VO²max), which indicates the amount of oxygen the body can use in one minute (Vučetić, & Šentija, 2005). The aerobic capacity (VO²max) is the “maximal amount of oxygen that human body can utilize per minute of activity or physical workout” (Dhara & Chatterjee, 2015, p. 9). Aerobic capacity, along with blood pressure and heart rate, is one of the key markers in the assessment of cardio respiratory fitness (Grant, Corbett, Amjad, Wilson, & Aitchison, 1995; Magutah, 2013), which is used in the assessment of cardio respiratory endurance of individuals (Dhara & Chatterjee, 2015).

Previous studies have shown that overweight research participants had worse results on cardio respiratory tests than the participants with normal weight. In addition, studies have confirmed low to moderately high inverse correlation between cardio respiratory fitness and obesity (Winsley et al., 2006; Ara et al., 2007). Low levels of cardio respiratory fitness and obesity in adolescence have been associated with a higher risk of mortality in adulthood (Apor, 2011). Cardio respiratory fitness has been found to be an independent determinant of a healthy lifestyle (Ferreira, Twisk, van Mechelen, Kemper, & Stehouwer, 2005). Higher values of aerobic capacity in childhood and adolescence have been strongly associated with the current level of health, but have also been found to be highly predictive of future development (Ruiz et al., 2007; Ortega et al., 2011).

Active lifestyle also implies participation in physical activity at recommended levels or involvement in organized implementation of physical activity; it is essential for the promotion of health-related physical fitness and is associated with health among young people. Avoiding sedentary lifestyle, even during the weekends, can prevent low levels of cardio respiratory fitness, especially in girls (Barbosa Filho, Lopes Ada, Bozza, Rech, & de Campos, 2014).

Cilj istraživanja bio je utvrditi da li djevojčice u dobi od četrnaest godina imaju više vrijednosti aerobnog kapaciteta od djevojčica u dobi od deset godina. U istraživanju se željelo utvrditi da li se porastom dobi smanjuje razina kardiorespiratornog fitnesa kod djevojčica, te da li se smanjuje ukupna tjelesna aktivnost.

METODE

U istraživanju je sudjelovalo 94 djevojčice od čega 52 učenice četvrtog razreda i 42 učenice osmog razreda osnovne škole. Učenice su pohađale tri osnovne škole u gradu Petrinji, Republika Hrvatska. Istraživanje je provedeno u školskoj godini 2015/2016. Sve učenice bile su zdrave te je za njihovo sudjelovanje u ispitivanju dobivena suglasnost roditelja prema Etičkom kodeksu istraživanja sa djecom. Uzorak varijabli činile su antropometrijske mjere: tjelesna visina, tjelesna težina, opseg struka, opseg bokova. Sve mjere provedene su prema International Biological Program (IBP). Visina tijela izmjerena je uz pomoć antropometra. Za procjenu tjelesne mase i postotaka masti u organizmu (BF%) korišten je instrument Omron (Tip BF511, Japan). Uređaj radi metodom bioelektrične impedancije temeljem tjelesnog otpora na osnovu kojeg se indirektno izračunava postotak masti u organizmu. Prije same provedbe mjerenja potrebno je unijeti vrijednosti tjelesne visine i tjelesne težine, dob i spol za svakog ispitanika. Aerobni kapacitet dobiven je višestupanjskim testom trčanja od 20 metara- Shuttle run testom (Leger & Lambert, 1982). Body mass indeks izračunat je temeljem formule $BMI (kg/m^2 = weight (kg) / (height (m))^2$

Razina tjelesne aktivnosti procijenjena je PAQ-C upitnikom (Crocker i sur. 1997). Upitnik je konstruiran za djecu mlađe školske dobi (od 8 do 14 godina). Cilj upitnika je procjena ukupne razine tjelesne aktivnosti učenika u posljednjih sedam dana. Upitnik se sastoji od 9 pitanja, a ukupni rezultat tjelesne aktivnosti predviđa se na temelju aritmetičke sredine dobivenih odgovora vrednovanih na ljestvici Likertova tipa od 1 do 5, gdje 1 označava nisku razinu tjelesne aktivnosti, a 5 označava visoku razinu tjelesne aktivnosti (Kowalski, Crocker i Donen, 2004). Isto tako učenici su procjenjivali vrijeme koje provedu pred televizijskim ekranom i na internetu.

Obrada podataka je obavljena programom STATISTICA (data analysis software system), version 7.1. Za sve istraživane varijable izračunati su osnovni deskriptivni parametri: aritmetička sredina (AS), standardna devijacija (SD), minimalan (MIN) i maksimalan (MAX) rezultat, te Skewness i Kurtosis. Značajnost razlika iz-

The **purpose** of this study was to determine whether aerobic capacity of fourteen-year-old girls is higher than that of ten-year-old girls. In addition, the study aimed to establish whether the levels of cardio respiratory fitness among girls decreases with age, and whether overall physical activity decreases as well.

METHODS

Research participants were 94 schoolgirls, of which 52 were fourth grade pupils, while 42 were eighth graders. The pupils attended three primary schools in the town of Petrinja, in the Republic of Croatia. The research was conducted during 2015/2016 school year. All the participants were healthy at the time of the research, and their participation was approved by the parents, in accordance with the Code of Ethics for Research Involving Children. The sample of variables included the following anthropometric measures: body height, body weight, waist circumference, and hips circumference. All the measurements were conducted according to the International Biological Program (IBP). Body height was measured with an anthropometer, and body weight and body fat percentage (BF%) were measured with the Omron (Type BF511, Japan). The device uses the method of bioelectrical impedance and body resistance on the basis of which body fat percentage is indirectly calculated. Prior to the measurement it is necessary to enter the data for body height, body weight, age and sex for each participant. A multistage 20m shuttle run test (Leger & Lambert, 1982) was used to obtain the values for aerobic capacity, and body mass index was calculated using the BMI formula, i.e. $weight (kg) / height (m)^2$

PAQ-C questionnaire (Crocker et al., 1997) was used to estimate the level of physical activity. The questionnaire was constructed for primary school children (eight to fourteen-year-olds) for the purpose of estimating the overall level of pupils' physical activity for the previous seven days. There are 9 questions in the questionnaire, and the overall result for the physical activity is estimated on the basis of the mean result of the obtained responses assessed on a five point Likert type scale, with 1 indicating a low and 5 indicating a high level of physical activity (Kowalski, Crocker, & Donen, 2004). The participants were also asked to estimate the time they spend in front of the television or on the Internet.

Data was processed with the STATISTICA (data analysis software system), version 7.1. Basic descriptive parameters were calculated for all of the variables: mean (M), standard deviation (SD), minimum (MIN) and maximum results (MAX), as well as Skewness and

među subuzoraka definiranih prema dobi kod rezultata sa normalnom distribucijom izračunata je t-testom, dok je kod rezultata koji su pokazali nenormalnost distribucije korišten neparametrijski Mann-Whitney U test. Relacije između funkcionalnog kapaciteta i razine tjelesne aktivnosti utvrđivane su Pearsonovim koeficijentom korelacije. Statistička značajnost razlika testirana je na razini značajnosti $p < 0,05$.

REZULTATI

Rezultati u tablici 1. za istraživane učenice prema razini tjelesne aktivnosti pokazuju da se njih 83% bave umjerenom tjelesnom aktivnošću (PA) odnosno da samo djelomično zadovoljavaju preporuke u participiranju svakodnevne tjelesne aktivnosti za djecu školske dobi.

Tabela 1. Rezultati učenica prema razini tjelesne aktivnosti

	Niska razina tjelesne aktivnosti / Low level of physical activity		Umjerena razina tjelesne aktivnosti / Moderate level of physical activity		Visoka razina tjelesne aktivnosti / High level of physical activity	
		%		%		%
Broj učenica / Number of pupils	11	12	78	83	5	5

Vidljivo je da samo 5% učenica zadovoljava preporuke o bavljenju tjelesnom aktivnošću, dok je 12% učenica potpuno tjelesno neaktivno što je vrlo visok postotak u odnosu na istraživani uzorak.

Tabela 2. Rezultati deskriptivnih pokazatelja za ukupan uzorak učenica

	N	Mean	Std.dev.	Min.	Max.	max D	K-S test
Age (years)	94	12,10	2,05	10,00	15,00		
Height (cm)	94	156,89	10,49	136,00	178,60	0,0951	$p > .20$
Weight (kg)	94	51,22	15,35	23,40	104,40	0,0687	$p > .20$
BMI-body mass index (kg/m ²)	94	20,48	4,58	12,65	35,66	0,1096	$p > .20$
Body fat (%)	94	23,90	9,50	3,00	41,90	0,0660	$p > .20$
Waist circumference (cm)	94	67,96	11,48	19,00	104,00	0,0907	$p > .20$
Hip circumference (cm)	94	88,77	12,20	62,00	121,00	0,0784	$p > .20$
VO ₂ max (mL/kg/min)	94	39,26	5,17	31,40	51,10	0,1279	$p < ,10$
Daily TV watching (hours)	94	1,89	1,02	0,00	4,00	0,2245	$p < ,01$
Daily internet (hours)	94	1,88	1,09	0,00	4,00	0,2706	$p < ,01$
PA level 7 days	94	2,79	0,63	1,70	4,15	0,0950	$p > .20$

Rezultati u tablici 2. prikazuju deskriptivne parametre istraživanih djevojčica koje pohađaju četvrti i osmi razred osnovne škole. **Prosječna dob je 12,10±2,05 godina.** Vidljivo je da su djevojčice prosječne visine

Kurtosis. The significance of the differences between the subsamples defined according to age was calculated using the t-test for the normally distributed results, and nonparametric Mann Whitney test was used to calculate the results which were not normally distributed. Pearson coefficient of correlation was used to calculate the correlations between the functional capacity and the level of physical activity. Statistical significance of the differences was tested at the level of significance $p < 0.05$.

RESULTS

The results for the level of physical activity presented in Table 1 show that in the target group of schoolgirls 83% participate in moderate physical activity (PA), in other words, they only partially meet the recommended level of participation in daily physical activities prescribed for school-aged children.

Table 1. Girls' results according to the level of physical activity

It may also be observed that only 5% of the schoolgirls meet the recommendations for the level of physical activity while 12% of the schoolgirls are completely physically inactive, which is a significant percentage in comparison to the total sample of participants in this research.

Table 2. Descriptive parameters for the total sample of girls

The results presented in Table 2 show the descriptive parameters for the fourth and eighth grade primary school girls. The average age was 12.10 ± 2.05 years. It may be observed that the girls' average height was $156.89 \pm$

156,89±10,49 cm što ih svrstava u djecu normalne tjelesne visine prema referentnim vrijednostima na razini Republike Hrvatske (Jureša, Kujundžić Tiljak i Musil, 2011). Gledajući rezultate tjelesne težine (51,22±15,35 kg), vidljivo je da istraživane učenice imaju veće vrijednosti tjelesne mase od referentnih vrijednosti na razini Republike Hrvatske (Jureša i sur., 2011). Rezultati postotka masti (%BF) iznosi 23,90 % što djevojčice ukupnog uzorka svrstava u normalno uhranjene ispitanike prema referentnima vrijednostima (McCarthy HD, Cole TJ, Fry T, Jebb SA i Prentice AM, 2006). Vrijednosti Body Mass Indeksa su nešto više u odnosu na referentne vrijednosti Republike Hrvatske (Jureša i sur., 2011). Rezultati opsega struka su u skladu sa referentnim vrijednostima, dok su rezultati opsega bokova viši od referentnih vrijednosti (Jureša i sur., 2011).

10.49cm, which means that according to the benchmark values determined for the Republic of Croatia (Jureša, Kujundžić Tiljak, & Musil, 2011) their height is normal. However, the results for body weight (51.22 ± 15.35 kg) indicate that the body mass of the schoolgirls in the present research was higher than the benchmark values determined for the Republic of Croatia (Jureša et al., 2011). The percentage of fat (BF%) in the target sample was 23.90%, which means that the total sample of schoolgirls, according to the benchmark values, may be classified as having normal body weight (McCarthy, Cole, Fry, Jebb, & Prentice, 2006). The body mass index values were slightly higher compared to the benchmark values for the Republic of Croatia (Jureša et al., 2011). Finally, the results for waist circumference were in line with the benchmarks while the results of the hips circumference were higher than the benchmark values (Jureša et al., 2011).

Tabela 3. Results of t-test and Mann Whitney test of anthropometric measures, aerobic capacity and physical activity between girls 10 and 14 age

Table 3. Results of t-test and Mann Whitney test for anthropometric measures, aerobic capacity and physical activity between girls aged 10 and 14

	10 years	14 years		
	52	42		
	Mean±SD	Mean±SD	t-test/p*	M-W test*
Age (years)	10,31±0,47	14,31±0,47		
Height (cm)	150,28±8,44	165,07±6,08		
Weight (kg)	45,40±14,28	58,43±13,59		
Waist circumference (cm)	65,50±12,15	71,00±9,90		
Hip circumference (cm)	83,95±11,78	94,74±9,95		
BMI-(kg/m ²)	19,79±4,73	21,34±4,30	0,10	/
Body fat (%)	22,48±10,49	25,66±7,87	0,11	/
VO ₂ max (mL/kg/min)	42,78±3,42	34,90±3,32	0,00	/
Daily TV watching	2,06±1,06	1,69±0,95	/	0,19
Daily internet	1,46±0,85	2,40±1,13	/	0,00
PA level 7 days	2,98±0,60	2,54±0,59	0,00	/

*t-test p=level of significance (p< 0.05); **Mann-Whitney U-test p=level of significance (p< 0.05)

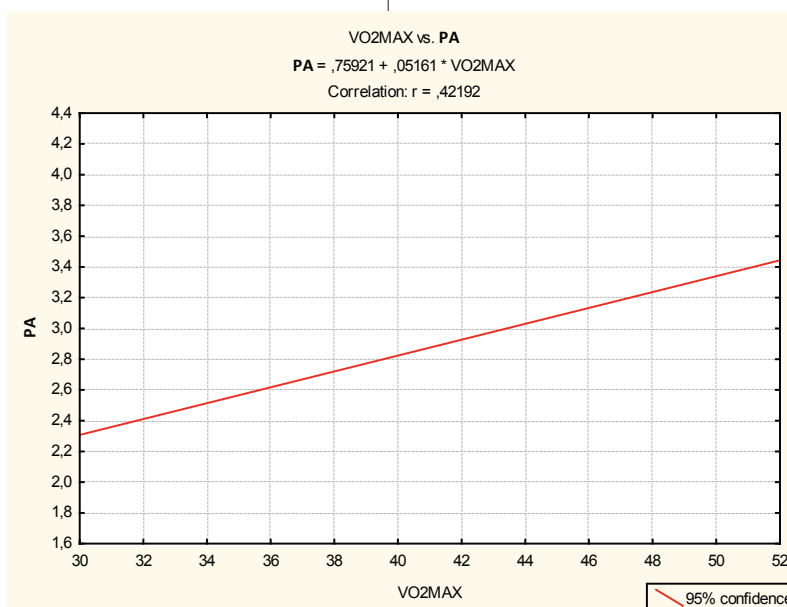
*t-test p=level of significance (p< 0.05); **Mann-Whitney U-test p=level of significance (p< 0.05)

Rezultati u tablici 3. prikazuju usporedne rezultate djevojčica prema njihovoj dobi. Vidljivo je da su starije učenice očekivano više tjelesne visine i tjelesne težine te da imaju više vrijednosti opsega struka i bokova što je sukladno rastu i razvoju čovjekova organizma i ove vrijednosti nisu bile predmet utvrđivanja razlika s obzirom na te činjenice. Za utvrđivanje razlika između ostalih varijabli koristio se t-test za nezavisne uzorke

Table 3 shows the comparison of the schoolgirls' results according to age. It is apparent that the values for body height and weight, as well as for waist and hips circumference, as expected, were higher for older pupils, which is in line with the growth and development of the human organism, therefore these values were not included in determining the differences between the two groups. In the between-group comparison of other variables the t-test

kod varijabli koje su pokazale normalnost distribucije, dok se kod varijabli koje su pokazale nenormalnost distribucije koristio neparametrijski Mann-Whitney U-test. Kod varijabli BMI (body mass indeks) i postotak masti (BF%) nisu utvrđene statistički značajne razlike. Razlika se pojavila kod varijable kojom se procjenjivao aerobni kapacitet gdje je utvrđena statistička značajnost u korist djevojčica u dobi od deset godina ($p=0,00$). Također, djevojčice u dobi od deset godina značajno više vremena provode u tjelesnoj aktivnosti ($p=0,00$), dok starije djevojčice dnevno više vremena provode na internetu ($p=0,00$).

Figure 1. Relations between the total physical activity (PA) and indicators of aerobic capacity (VO₂max) in girls



Temeljem rezultata prikazanih u slici 1. vidljivo je da korelacija između aerobnog kapaciteta (VO₂max) i ukupne tjelesne aktivnosti (PA) pokazuje značajnu pozitivnu povezanost ($r = 0,42$; $p = 0,00$).

DISKUSIJA I ZAKLJUČAK

Dobiveni rezultati pokazuju da samo 12% istraživačkih učenica zadovoljava preporuke o provođenju dnevne tjelesne aktivnosti. Uspoređujući dobivene rezultate sa istraživanjem (Currie i sur., 2012), gdje je vidljivo da su djevojčice u Republici Hrvatskoj u dobi od 11-15 godine participirali između 19% i 8% u preporučenoj tjelesnoj aktivnosti, može se utvrditi da su učenice ostale na istim razinama u odnosu na prošle godine. Temeljem cilja istraživanja vidljivo je da djevojčice u dobi od deset godina imaju značajno bolji aerobni kapacitet od starijih djevojčica. Neke dosadašnje studije pokazale su da djevojčice u dobi od 14-15 godina imaju niže vrijednosti VO₂max

for independent samples was used for the variables that showed normality of the distribution, while for the variables that did not show a normal distribution the nonparametric Mann-Whitney U-test was used. For the variables BMI (body mass index) and body fat percentage (BF%) no statistically significant differences were found. The difference was determined for the variables that were used to evaluate aerobic capacity, and the difference was statistically significant in favour of ten-year-old girls ($p = 0.00$). Also, the ten-year olds reportedly spend significantly more time in physical activity ($p = 0.00$) while the older girls spend more time daily on the Internet ($p = 0.00$).

Figure 1. Relations between the total physical activity (PA) and indicators of aerobic capacity (VO₂max) in girls

Based on the results presented in Figure 1, it may be observed that there is a significant positive correlation ($r = 0.42$; $p = 0.00$) between the aerobic capacity (VO₂max) and the overall physical activity (PA).

DISCUSSION AND CONCLUSION

The results show that only 12% of the investigated schoolgirls meet the recommendations on the participation in daily physical activity. Comparing the obtained results with another research (Currie et al., 2012), which indicated that between 8% and 19% of eleven to fifteen-year-old schoolgirls in the Republic of Croatia met the recommended level of physical activity, it can be determined that the girls have remained at the same levels compared to previous years. Pertaining to the objective of the research, it may be observed that ten-year-old girls have significantly better aerobic capacity than the older girls. Some previous studies have also shown that girls

(Ruiz et al., 2007; Lobelo et al., 2009; Adegboye et al., 2011; Ortega et al., 2011; Barbosa Filho et al., 2014) od djevojčica mlađe dobi. Također, vidljivo je da djevojčice u dobi od deset godina imaju vrijednosti kardiorespiratornog fitnessa (CF) 42,78 (mL/kg/min) što je nominalno viša vrijednost od istraživanja Gahche i suradnika (2014) koji su kod djevojčica dobi 12-13 godina dobili vrijednosti 35,7 (mL/kg/min), a kod djevojčica dobi 14-15 godina 31,8 (mL/kg/min) što je nešto niža vrijednost u odnosu na ovo istraživanje (34,90 mL/kg/min). Razlog značajnog smanjivanja aerobnog kapaciteta osim tjelesne neaktivnosti prema Dencker et al. (2007) ogleda se u razvoju spolnih hormona i distribucije tjelesne masti. Promatrajući vrijeme koje djeca provode u sedentarnim aktivnostima, uočljivo je da su mlađe djevojčice više vremena provodile gledajući televizor, ali nije utvrđena statistička značajnost, dok se kod vremena koje djevojčice provode na internetu pojavila značajna razlika u korist starijih djevojčica. Naravno, mlađe djevojčice još uvijek su zainteresirane za zabavu pred televizijskim ekranima dok su starije djevojčice više orijentirane na internet, gdje se razlog može tražiti u povezivanju sa svojim prijateljima bilo da se radi o povezivanju preko socijalnih mreža ili igranju online igrica preko interneta. Isto tako, mlađe djevojčice prema samoprocjeni tjelesne aktivnosti, značajno više vremena dnevno provode u nekom od oblika tjelesne aktivnosti od starijih djevojčica. Kada se uspoređi vrijeme koje starije djevojčice provode ispred TV ekrana i interneta, onda je jasno da su njihove preferencije usmjerene na sedentarne aktivnosti odnosno da daju prednost aktivnostima koje ne zahtijevaju energetsku potrošnju. Ova činjenica može se ogledati i u nalazu istraživanja gdje mlađe djevojčice imaju značajno bolje rezultate aerobnog kapaciteta. Pearsonovim koeficijentom korelacije utvrđena je značajna pozitivna korelacija između aerobnog kapaciteta i dnevne tjelesne aktivnosti kod istraživanih djevojčica. Slične rezultate dobivena su u istraživanju (Collings et al. 2016). Aerobni kapacitet značajno se povećava participiranjem u tjelesnoj aktivnosti. Bez obzira što drugi čimbenici, kao što su spol, dob, sastav tijela i zdravstveno stanje mogu značajno utjecati na razinu kardiorespiratornog fitnessa, no najvažnija odrednica koja može mijenjati razinu aerobnog kapaciteta je tjelesna aktivnost (Parikh i Stratton, 2011).

Činjenice dobivene ovim istraživanjem govore da se aerobni kapacitet kod djevojčica ulaskom u pubertet smanjuje i u korelaciji sa tjelesnom neaktivnošću može uzrokovati ozbiljne zdravstvene probleme. Nalazi temeljeni na provedenim interventnim studijama pokazuju da se razina kardiorespiratornog fitnessa može poboljšati u

aged fourteen to fifteen had lower values of VO₂max than the younger girls (Ruiz et al., 2007; Lobe et al., 2009; Adegboye et al., 2011; Ortega et al., 2011; Barbosa Filho et al., 2014). Moreover, it was found that the value of cardio respiratory fitness (CF) of ten-year-old girls was 42.78 (mL/kg/min), which is nominally a higher value than the values obtained in the research by Gahche et al. (2014), who found that twelve to thirteen-year-old girls' value was 35.7 (mL/kg/min) and fourteen to fifteen-year-old girls' value was 31.8 (mL/kg/min), which is a slightly lower value compared to our study (34.90 mL/kg/min). The reason for the significant reduction of aerobic capacity, in addition to physical inactivity, according to Dencker et al. (2007), may be the development of sex hormones and the distribution of body fat. Upon the analysis of the time children spend in sedentary activities, it is evident that the younger girls spent more time watching television, although there was no statistically significant difference, while the older girls spent statistically significantly more time on the Internet. Naturally, the younger girls are still interested in the entertainment provided by the television while the older girls are more oriented to the Internet, which enables them to connect with their friends through social networks, or to play online games. In addition, according to their self-report, the younger girls spend significantly more time participating in some form of physical activity than the older girls. When the time that the older girls spend in front of TV screens and the Internet is compared, it is clear that their preferences are aimed at sedentary activities, i.e. they give priority to activities that do not require energy consumption. This finding is confirmed by the result indicating that younger girls have a significantly better aerobic capacity. Pearson correlation coefficient confirmed a significant positive correlation between aerobic capacity and daily physical activity in the studied sample of schoolgirls. Similar results were obtained in the study by Collings et al. (2016). Aerobic capacity significantly increases through participation in physical activity. Irrespective of other factors, such as sex, age and body composition, state of health can significantly affect the level of cardio respiratory fitness. Nevertheless, the most important factor that can change the level of aerobic capacity is physical activity (Parikh & Stratton, 2011).

The results obtained in the present study show that aerobic capacity in schoolgirls decreases as they enter puberty, and in correlation with physical inactivity it can cause serious health problems. Results based on some intervention studies indicate that the level of cardio respiratory fitness can be improved in youth through aerobic

mladosti kroz aerobni trening (Parikh i Stratton, 2011).

Djevojčice koje ne provode tjelesnu aktivnost u preporučenom vremenu od minimalno 60 minuta dnevno trebale bi se uključiti kroz različite interventne programe u dodatno tjelesno vježbanje. Sudjelovanje samo u nastavi tjelesne i zdravstvene kulture nije dovoljno za podizanje razine aerobnog kapaciteta kod djevojčica u dobi između desete i četrnaeste godine.

Na kraju može se zaključiti da djevojčice istraživa-
ne dobi imaju relativno nisku razinu aerobnog kapaciteta
te se ukazuje na potrebu njihova usmjeravanja u različite
oblike zdravog načina života s posebnim naglaskom na
svakodnevno tjelesno vježbanje.

Izjava autora

Autori pridonijeli jednako.

Konflikt interesa

Mi izjavljujemo da nemamo konflikt interesa.

training (Parikh & Stratton, 2011).

Girls who do not participate in physical activity at least for the recommended time of a minimum of 60 minutes a day should be involved in additional physical exercise through various intervention programmes. More participation in physical education lessons is not enough to raise the level of aerobic capacity in girls between the ages of ten and fourteen.

Finally, it may be concluded that girls of the target age (fourteen years) have relatively low levels of aerobic capacity, and therefore there is a need to direct them towards various forms of healthy lifestyle with special emphasis on daily physical exercise.

Authorship statement

The authors have contributed equally.

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We declare that we have no conflicts of interest.

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Kratko saopštenje

Short notice

OSLOBOĐANJE UČENIKA SREDNJIH ŠKOLA OD NASTAVE FIZIČKOG VASPITANJA

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Abstrakt: Fizičko vaspitanje se danas suočava sa mnogim izazovima, a jedan od njih je oslobađanje učenika od nastave fizičkog vaspitanja. Dosadašnje studije pokazuju da razlozi za oslobađanje učenika od nastave fizičkog vaspitanja nisu uvek samo medicinski, da se pravi razlozi kriju u nedostatku motivacije, zatim diskomunikaciji sa nastavnikom fizičkog vaspitanja, itd. Cilj ovog istraživanja je da se ispita problem oslobađanja učenika od nastave fizičkog vaspitanja u srednjim školama. Uzorak obuhvata 5226 učenika srednjih novosadskih škola, 2068 dečaka i 3158 devojčica. Podaci su analizirani deskriptivnom statistikom i uz pomoć χ^2 testa. Pored toga sprovedeni su konverzacijski intervjui sa nastavnicima fizičkog vaspitanja. Ukupan procenat oslobođenih učenika je bio 3.73%. Statistički značajne relacije utvrđene su između polne pripadnosti učenika i oslobađanja od nastave fizičkog vaspitanja, dok uzrast učenika i pol nastavnika fizičkog vaspitanja nisu značajno povezani sa oslobađanjem. Rezultati pokazuju da učenice više izostaju sa nastave fizičkog vaspitanja u srednjim školama od svojih vršnjaka muškog pola. Kvalitativna analiza je pokazala da pored medicinskih razloga postoje i neki drugi razlozi zbog kojih se učenici oslobađaju od nastave fizičkog vaspitanja: slabije interesovanje za fizičku aktivnost, nastavni sadržaji koji ne zadovoljavaju potrebe učenika, nezadovoljstvo fizičkim izgledom, percepcije učenika da su fizička aktivnost i sport nefeminine aktivnosti, itd. Nastavnici fizičkog vaspitanja ubuduće bi trebalo da planiraju čas koji je raznovrstan, koristan i interesantan učenicima kako bi ih motivisali da vode aktivan način života.

Ključne reči: fizičko vaspitanje, medicinsko oslobađanje, učenici srednje škole.

Uvod

Problem oslobađanja učenika od nastave fizičkog vaspitanja postoji od kada postoji nastava fizičkog vaspitanja u školama (Ivanić, 1974; Konstantinović, 1969; Stojanović & Vučo, 1969). Iako fizičko vaspitanje pozitivno utiče na fizičko i mentalno zdravlje kod mladih, mnogi

MEDICAL EXEMPTION FROM PHYSICAL EDUCATION IN SECONDARY SCHOOL STUDENTS

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Abstract: Physical education of today faces many challenges, one of them being students' medical exemption. Previous studies suggest that reasons for exemption from physical education might not be only medical, but related to students' lack of motivation, miscommunication with PE teacher etc. The aim of the study was to examine the extent of the problem of medical exemption from physical education in secondary schools. The sample included 5226 students, 2068 males and 3158 females, from secondary schools in Novi Sad (Serbia). Data were analyzed by descriptive statistics and chi-square test. In addition a set of conversational interviews with PE teachers was conducted and analyzed. Total percentage of medically exempted students was 3.73%. A significant relation between gender and medical exemption was identified, while age and PE teachers' gender were not significantly related to medical exemption. The results indicate that female students are more likely to be medically exempted from physical education in secondary school than their male counterparts. Qualitative data revealed that in addition to medical reasons, there might be others, as well: less interest in physical activity, instructional content that does not meet students' needs, self-consciousness about physical appearance, girls' perceptions of physical activity and sports as non-feminine, etc. PE teachers should plan for diverse and positive learning experiences for all student, while motivating them to develop an active lifestyle.

Keywords: physical education, medical exemption, secondary school students

INTRODUCTION

The problem of students' medical exemption in physical education is as old as physical education itself (Ivanić, 1974; Konstantinović, 1969; Stojanović & Vučo, 1969). Although physical education benefits physical and mental health of youth, many students, especially in secondary schools, are exempted from PE classes. The stu-

učenici, potovo učenici srednjih škola, izostaju sa nastave fizičkog vaspitanja. Učenici mogu da budu oslobođeni od nastave fizičkog vaspitanja privremeno ili tokom cele školske godine (potpuno ili delimično), a ova procedura je regulisana zakonom (Zakon o srednjoj školi, 2005). Veliki procenat oslobođenih učenika (od 3% do 10%), struktura oslobođenih učenika i drugi pokazatelji, ukazuje da pored određenih zdravstvenih poteškoća i bolesti postoje i drugi razlozi za oslobađanje učenika, koji nisu medicinski. Na primer, dve trećine učenika oslobođenih od nastave fizičkog vaspitanja se bave fizičkom aktivnošću u slobodno vreme, uključujući i intenzivne fizičke aktivnosti (Đorđić & But, 2013). Kao najčešće nemedicinske razloge za oslobađanje sa časova fizičkog vaspitanja, učenici navode rizik od povređivanja, obavezno nošenje opreme za fizičko, slabo interesovanje za fizičku aktivnost, prevelike zahteve nastavnika fizičkog vaspitanja, nastavne sadržaje koji ne zadovoljavaju njihove potrebe, nezadovoljstvo fizičkim izgledom (Radovanović, Todorović & Đorđić, 1995). Iako ovi razlozi narušavaju pravila za izdavanje potvrde za oslobađanje učenika od nastave fizičkog vaspitanja, oni se razmatraju kako bi se broj oslobođenih učenika smanjio.

Cilj istraživanja je bio da istraži problem oslobađanja učenika od nastave fizičkog vaspitanja u srednjim školama i utvrdi da li broj oslobođenih učenika varira u odnosu na razred, pol učenika i pol nastavnika fizičkog vaspitanja.

METOD

Transverzalna studija obuhvatila je učenike različitih obrazovnih profila četiri srednje škole u Novom Sadu (Srbija). Uzorak ispitanika je obuhvatio 5226 učenika od prvog do četvrtog razreda, 2068 dečaka (39.57%) i 3158 devojčica (60.43%). Upitnik za oslobođene učenike je osmišljen tako da obuhvati relevantne informacije o oslobađanju od nastave fizičkog vaspitanja. Ispitivač je nadgledao popunjavanje upitnika. Sa ciljem da se dobiju potpuniji podaci o oslobađanju učenika, sprovedeni su konverzacijski intervjui sa nastavnicima fizičkog vaspitanja (N = 8) koji predaju u školama u kojima se vršilo istraživanje. Podaci su analizirani deskriptivnom statistikom, uz pomoć χ^2 testa (upitnik) i kvalitativne analize zabeleženih intervjua.

REZULTATI

Broj potpuno oslobođenih učenika od nastave fizičkog vaspitanja je iznosio 195, od čega 52 dečaka i 143 devojčice. Procenat oslobođenih učenika od nastave fizičkog vaspitanja je iznosio 3.73% na nivou celog uzorka, 2.5% kod dečaka i 4.5% kod devojčica. Hi-kvadrat test je primenjen radi analize relacija između pola i broja oslobođenih učenika. Relacija između ove dve varijable

može biti medicinski oslobađanje od nastave fizičkog vaspitanja. Učenici mogu da budu oslobođeni od nastave fizičkog vaspitanja privremeno ili tokom cele školske godine (potpuno ili delimično), a ova procedura je regulisana zakonom (Zakon o srednjoj školi, 2005). Veliki procenat oslobođenih učenika (od 3% do 10%), struktura oslobođenih učenika i drugi pokazatelji, ukazuje da pored određenih zdravstvenih poteškoća i bolesti postoje i drugi razlozi za oslobađanje učenika, koji nisu medicinski. Na primer, dve trećine učenika oslobođenih od nastave fizičkog vaspitanja se bave fizičkom aktivnošću u slobodno vreme, uključujući i intenzivne fizičke aktivnosti (Đorđić & But, 2013). Kao najčešće nemedicinske razloge za oslobađanje sa časova fizičkog vaspitanja, učenici navode rizik od povređivanja, obavezno nošenje opreme za fizičko, slabo interesovanje za fizičku aktivnost, prevelike zahteve nastavnika fizičkog vaspitanja, nastavne sadržaje koji ne zadovoljavaju njihove potrebe, nezadovoljstvo fizičkim izgledom (Radovanović, Todorović & Đorđić, 1995). Iako ovi razlozi narušavaju pravila za izdavanje potvrde za oslobađanje učenika od nastave fizičkog vaspitanja, oni se razmatraju kako bi se broj oslobođenih učenika smanjio.

Cilj istraživanja je bio da istraži problem oslobađanja učenika od nastave fizičkog vaspitanja u srednjim školama i utvrdi da li broj oslobođenih učenika varira u odnosu na razred, pol učenika i pol nastavnika fizičkog vaspitanja.

METHOD

The cross-sectional study employed the sample of four secondary schools from Novi Sad (Serbia), comprising different educational profiles. Participants were 5226 first to fourth grade students, 2068 males (39.57%) and 3158 females (60.43%). The questionnaire for students was designed in order to gain relevant information on medical exemption from physical education. The investigator supervised the data collection. In order to get more balanced information on medical exemption, a set of conversational interviews with physical education teachers (N = 8) from participating schools were conducted. Data were analyzed by descriptive statistics and chi-square test (questionnaire) and by qualitative analysis of interview notes.

RESULTS

The number of fully medically exempted students reached 195, 52 males and 143 females included. The prevalence of fully medically exempted students was 3.73%, 2.5% in males and 4.5% in females. A chi-square test of independence was performed in order to analyze the relation between students' gender and medical exemption. The relation between these variables was

je statistički značajna, $\chi^2(1, N = 5226) = 13.55, p < 0.01$ (Tabela 1). Proporcija dečaka oslobođenih od nastave fizičkog vaspitanja je značajno manja od proporcije devojčica koje su oslobođene od nastave fizičkog vaspitanja.

Tabela 1. Zastupljenost oslobodanja od nastave fizičkog vaspitanja među učenicima srednje škole

Pol / Gender	Oslobođeni učenici / Medically exempted	Redovni učenici / Not exempted	Ukupno / Total
Dečaci / Male	52 (2.51%)	2016 (97.49%)	2068 (100%)
Devojčice / Female	143 (4.53%)	3015 (95.47%)	3158 (100%)
Ukupno / Total	195 (3.73%)	5031 (96.27%)	5226 (100%)

$\chi^2(1, N = 5226) = 13.55, p = 0.002$

Rezultati χ^2 testa pokazuju da ne postoji statistički značajna razlika u zastupljenosti oslobodanja od nastave između učenika različitih razreda, $\chi^2(1, N = 5226) = 5.06, p > 0.05$ (Tabela 2). Iako nije utvrđena statistički značajna relacija, može se konstatovati da je procenat oslobođenih učenika u blagom porastu, od 2.46% u drugom razredu do 3.60% u četvrtom razredu.

Tabela 2. Zastupljenost oslobodanja od nastave fizičkog vaspitanja po razredima

Pol / Gender	Oslobođeni učenici / Medically exempted	Redovni učenici / Not exempted	Ukupno / Total
I	43 (2.52%)	1667 (97.48%)	1710 (100%)
II	42 (2.46%)	1663 (97.54%)	1705 (100%)
III	49 (2.89%)	1648 (97.11%)	1697 (100%)
IV	61 (3.60%)	1632 (96.40%)	1693 (100%)

$\chi^2(1, N = 5226) = 5.06, p = 0.168$

Testiranje hi-kvadrat testom nije potvrdilo značajnost relacije između pola nastavnika fizičkog vaspitanja i pola oslobođenih učenika od nastave fizičkog vaspitanja, $\chi^2(1, N = 195) = 0.84, p > 0.05$ (Tabela 3). Proporcija devojčica/dečaka oslobođenih od nastave fizičkog vaspitanja ne razlikuje se značajno u zavisnosti da li je nastavnik fizičkog vaspitanja koji im predaje ženskog ili muškog pola.

Tabela 3. Oslobađanje učenika od nastave fizičkog vaspitanja u zavisnosti od pola nastavnika fizičkog vaspitanja

Pol nastavnika fizičkog vaspitanja / PE teacher gender	Oslobođeni dečaci / Medically exempted male students	Oslobođene devojčice / Medically exempted female students	Ukupno / Total
Muški / Male	30 (30.00%)	70 (70.00%)	100 (100%)
Ženski / Female	22 (23.16%)	73 (76.84%)	95 (100%)

$\chi^2(1, N = 195) = 0.84, p = 0.360$

significant, $\chi^2(1, N = 5226) = 13.55, p < 0.01$ (Table 1). Male students were less likely to be medically exempted from physical education classes than were female students.

Table 1. The prevalence of medically exempted students in secondary schools

$\chi^2(1, N = 5226) = 13.55, p = 0.002$

According to the results of a chi-square test, there is no significant relation between students' grade and medical exemption, $\chi^2(1, N = 5226) = 5.06, p > 0.05$ (Table 2). However, the percentage of medically exempted students slightly increases with grade, from 2.46% in second grade to 3.60 in fourth grade.

Table 2. Medical exemption from physical education by gender

$\chi^2(1, N = 5226) = 5.06, p = 0.168$

In order to examine the relation between PE teacher gender and gender of medically exempted students, a chi-square test of independence was conducted. The results show that there is no significant relation between these two variables, $\chi^2(1, N = 195) = 0.84, p > 0.05$ (Table 3). The percentage of medically exempted students of both gender did not vary by gender of their PE teacher.

Table 3. Medical exemption from physical education by PE teacher gender

$\chi^2(1, N = 195) = 0.84, p = 0.360$

Intervjui sa nastavnicima fizičkog vaspitanja pokazuju da su oni uvereni, da u nekim slučajevima, pored medicinskih razloga, postoje i drugi, nemedicinski razlozi za izostajanje sa nastave fizičkog vaspitanja. Razlozi koje navode su:

- Nedostatak motivacije, posebno kod učenika koji su manje kompetentni u sportskom domenu;
- Nedostatak samopouzdanja zbog fizičkog izgleda (npr. kod gojaznih učenika);
- Izbegavanje aktivnosti koje im se ne sviđaju ili gde je prisutan strah (npr. sportske igre, vežbe na spravama i tlu);
- Izbegavanje presvlačenja u opremu za fizičko;
- Percepcije devojčica da su pojedini aspekti časa fizičkog vaspitanja (npr. znojenje, prljanje tokom aktivnosti) neadekvatni u kontekstu femininosti.

ZAKLJUČCI SA DISKUSIJOM

Istraživanje je sprovedeno sa ciljem da istraži problem oslobađanja učenika od nastave fizičkog vaspitanja u srednjim školama. U skladu sa proporcijom oslobođenih učenika dobijenim u prethodnim istraživanjima, rezultati pokazuju da ukupan procenat potpuno oslobođenih učenika od nastave fizičkog vaspitanja iznosi 3.73%, kod dečaka iznosi 2.5%, a kod devojčica 4.53%. Radi se o značajnoj razlici, a veća zastupljenost devojčica u kategoriji oslobođenih učenika je nalaz konzistentan sa prethodnim istraživanjima. S druge strane, iako procenat oslobođenih učenika blago raste sa uzrastom, dobijene razlike nisu statistički značajne. Relacije između pola nastavnika fizičkog vaspitanja i pola učenika oslobođenih od nastave fizičkog vaspitanja takođe nisu statistički značajne. Ova relacija je ispitivana s obzirom da postoje istraživanja koja ukazuju da se nastavni stilovi nastavnika fizičkog vaspitanja razlikuju u zavisnosti od njihove polne pripadnosti (Al-Mullah, 1998; MacDonald, 1990; Macfadyen & Campbell, 2005).

Dobijene razlike u proporciji oslobođenih devojčica i dečaka, mogu se tumačiti i u kontekstu prethodnih nalaza koji sugerišu da dečaci više vole fizičko vaspitanje od devojčica, da su aktivniji, kompetitivniji, da preferiraju kontaktne i takmičarske aktivnosti (koje dominiraju u nastavnom programu), te da koedukativni ambijent u fizičkom vaspitanju opažaju pozitivnije od devojčica (Đordić i Krneta, 2007). Intervjuisani nastavnici fizičkog vaspitanja takođe pretpostavljaju da pored medicinskih razloga, i drugi razlozi u pojedinim slučajevima imaju značajnu ulogu u oslobađanju učenika od nastave fizičkog vaspitanja. Ovi razlozi, koji se kreću u rasponu od nedovoljnog interesovanja učenika i izbegavanja pojedinih aktivnosti, pa do izbegavanja vežbanja jer dovodi do preznojanja, moraju se svakako pažljivo razmotriti.

Interviews with physical education teachers revealed that they believed that, in some cases along with medical reasons, other subjective reasons for being released from classes of physical education might be involved. These reasons are:

- Lack of motivation, especially in students who are less competent in sport domain;
- Lack of self-confidence in terms of physical appearance (e.g. obese students);
- Avoiding activities they do not like or are afraid of (e.g. games, gymnastics);
- Avoiding changing into PE uniform;
- Girls perceptions that some aspects of physical education classes are not feminine (e.g. getting sweaty and dirty).

CONCLUSIONS WITH THE DISCUSSION

The study was conducted in order to examine the extent of the medical exemption issue in secondary physical education. The results are in accordance with previous findings, with percentage of fully medically exempted students reaching 3.73% in total, 2.5% in boys, but as much as 4.53% in females. The difference is significant, and underrepresentation of boys in exempted group of students is consistent with previous findings. On the other hand, although the proportion of exempted students slightly increases by age, the differences are not significant. The relationship between gender of PE teacher and gender of exempted students was not significant either. This might suggest that the gender of PE teacher does not affect the students' exemption from physical education classes. This relationship was analyzed because some studies indicated gender differences in teaching styles of physical education teachers (Al-Mullah, 1998; MacDonald, 1990; Macfadyen & Campbell, 2005).

The significant gender differences in medical exemption might be interpreted in terms of previous findings suggesting that boys prefer physical education in comparison to girls, they are more active, prefer contact and competitive activities (which dominate in physical education curriculum), and perceive the mix-gender classes more positive (Đordić & Krneta, 2007). Interviewed physical education teachers also assume that behind medical reasons, in some cases other reasons have a significant role in physical education exemption. These reasons, ranging from disliking ball games to avoiding sweating and not being interested in physical activity in general, have to be considered carefully.

The physical education teacher should cater for different needs of his/her students. The learning environment has to be safe and supportive in order to enhance

Okruženje u kojem se realizuje nastava mora da bude bezbedno, a nastavnik fizičkog vaspitanja mora da pruži podršku učenicima sa ciljem da doprinese učenju. Motivisati učenike da budu aktivni na nastavi fizičkog vaspitanja može predstavljati izazov, posebno u adolescenciji koja se smatra faktorom rizika za neaktivnost (Rowland, 1999). Samoodređenu motivaciju učenika treba podsticati interesantnim aktivnostima, inovativnim pristupima i obezbeđivanjem optimalnih izazova za sve učenike, uključujući i one sa medicinskim problemima. Takođe, učenike treba konsultovati i uključiti u procese planiranja odgovarajućeg kurikuluma fizičkog vaspitanja. Određene karakteristike učenika (pol, uzrast, samoeфикаsnost, uspeh u školi, itd) mogu biti povezane sa izbegavanjem časova fizičkog vaspitanja.

Da bi se utvrdio glavni razlog pseudo oslobađanja od obavezne nastave fizičkog vaspitanja, neophodna su kompleksnija istraživanja. Ova oslobađanja prikrivaju neke stvarne probleme u fizičkom vaspitanju i imaju štetne posledice po oslobođene učenike, jer osujećuju njihovo redovno učestvovanje u nastavi fizičkog vaspitanja. Dakle, oslobađanje učenika od nastave fizičkog vaspitanja predstavlja bitan obrazovni, psihološki i zdravstveni problem koji zahteva dalju pažnju.

Izjava autora

Autori pridonijeli jednako.

Konflikt interesa

Mi izjavljujemo da nemamo konflikt interesa.

the learning in physical education. Motivating student to be active participants in physical education class might be challenging, especially in adolescence which is considered to be a risk factor for inactivity (Rowland, 1999). Students' self-determined motivation should be reinforced by interesting activities, innovative approaches, and by providing optimal challenges to all students, including those with medical issues. In addition, students should be more consulted and involved in the process of developing an appropriate physical education curriculum. Certain characteristics of students (gender, age, self-efficacy, school achievement, etc.) might be related to their exemption from physical education classes.

More complex studies are needed to establish the major cause of "false" medical exemption in the context of obligatory physical education classes. These exemptions conceal some real problems in physical education, and might cause adverse consequences to exempted students by preventing them from regular physical education. Therefore, students exemption from physical education classes present an important educational, psychological and health problem, and requires further attention.

Authorship statement

The authors have contributed equally.

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We declare that we have no conflicts of interest.

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Kratko saopštenje

Short notice

PRIMJENA FUNKCIONALNOG TRENINGA U VRHUNSKOM SPORTU I REKREACIJI

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Abstrakt: Cilj rada je primjenom anketnog upitnika utvrditi mišljenje trenera o mogućnostima i efikasnosti primjene funkcionalnog treninga u vrhunskom sportu i rekreaciji. Kako bi se dobili relevantni podaci o značaju funkcionalnog treninga u vrhunskom sportu i rekreaciji, anketa je provedena na uzorku koji se sastojao od 25 trenera različite uzrasne dobi, spola, grane sporta i sportskog staža. Rezultati ankete pokazali su kako funkcionalni trening spada među najpopularnije sisteme treninga u vrhunskom sportu i rekreaciji, te da ga treneri u značajnoj mjeri koriste u svom praktičnom radu. Prema mišljenju anketiranih trenera za funkcionalni trening je najvažnije naglasiti kako se on temelji na vježbama koje obuhvataju cijelo tijelo i pri tome dolazi do aktivacije više mišićnih grupa u trenutku samog izvođenja. Funkcionalni trening utiče na razvoj motoričkih sposobnosti kao što su jakost, snaga, koordinacija, ravnoteža, fleksibilnost, brzina, mišićna izdržljivost. Također, treneri su mišljenja da funkcionalni trening značajno utiče i na razvoj energogenih sistema (fosfatni, glikolitički i aerobni), smanjenje masnog tkiva (potkožnog i visceralnog), toniziranje i uvećanje mišićne mase, subjektivnog osjećaja moći i regulisanje nivoa stresa.

Cljučne riječi: funkcionalni trening, sport, rekreacija, primjena, anketa

*Naša najveća snaga nije u tome da nikad ne padnemo,
već da se svaki put kad padnemo – podignemo.*

Konfučije

Uvod

Funkcionalni trening u ovom trenutku spada među najpopularnije sisteme treninga u svijetu. Ovakva vrsta treninga potiče iz rehabilitacije, kada je 1990-ih terapeut Gary Gray pokret u rehabilitacijske svrhe posmatrao kao lanac pokreta (prema: Mlinarić, 2012). Do tada su se

APPLICATION OF FUNCTIONAL TRAINING IN HIGH SPORTS AND RECREATION

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Abstract: The aim of this work is to determine attitudes if trainers about possibilities and efficiency of application of functional training in high sports and recreation. In order to obtain relevant information about the importance of functional training in top sport and recreation, the survey was conducted on a sample consisting of 25 coaches of different age groups, gender, branch of sport and sports experience. The survey results showed that functional training is one of the most popular systems of training in top sport and recreation and that coaches use in their practical work. According to the respondents coach for functional training is important to point out that it is based on exercises that include our whole body and thereby leads to the activation of more muscle groups at the time of its execution. It affects the development of motor skills such as strength, power, coordination, balance, flexibility, speed, muscular endurance. Trainers also claim that functional training effects the development of energy systems (phosphate, glycolytic and aerobic), and reduction of body fat (subcutaneous and visceral), toning and increasing muscle mass, subjective sense of power and regulating stress levels.

Keywords: functional training, sport, recreation, application, survey.

*Our greatest glory is not in never falling, but in
rising every time we fall.*

Confucius

INTRODUCTION

Functional training at the moment is one of the most popular systems of training in the world. This kind of training comes from rehabilitation, when the 1990s therapist Gary Gray began to consider the movement in rehabilitation purposes as kinetic chain (to: Mlinarić, 2012).

zglobovi najčešće posmatrali izolovano, kao i mišići koji pokreću te zglobove. Kinetički lanci su zapravo povezani zglobovi i mišići koji zajedno izvode neki pokret. Komplex pokreta koje izaziva mišić neposredno u predjelu svoje lokacije i posredno na susjedne dijelove tijela naziva se kinetički lanac (Mikić i sur., 2006).

Mnogi autori daju svoja objašnjenja o tome šta je funkcionalni trening:

- Višezglobna aktivnost u više pravaca, koja uključuje usporavanje, ubrzavanje i stabilizaciju uz kontrolisanu nestabilnost (Gambetta, 1998);
- Spektar aktivnosti koje poboljšavaju spremnost tijela, a u skladu su s ugrađenim sistemom pokreta (Santana, 2002);
- Kontinuum vježbi koje uključuju ravnotežu i propriocepciju, koje se izvode sa stopalima na tlu bez pomoći sprava. (Boyle, 2003).

Funkcionalnim treningom vježbamo cijelo tijelo, jer se izolovane vježbe gotovo i ne rade, a pokušava se aktivirati što više mišićnih grupa u isto vrijeme, te objediniti dvije osnovne radnje sa tijelom: potisci (čučanj, sklekovi...) i povlačenja (zglobovi, uključuje ravnotežu, propriocepciju, "mrtvo dizanje"...). U relativno kratkom vremenu radi se na snazi, eksplozivnosti, izdržljivosti, fleksibilnosti, brzini i psihičkoj komponenti, što ga čini najkompletnijim načinom treniranja (Mikić i Bašinc, 2012). Funkcionalni trening se zasniva na prirodnom pokretu, uključujući ravnotežu i propriocepciju.

Đurković (2011) navodi kako funkcionalni trening najviše odgovara pripadnicima specijalnih jedinica u oružanim snagama i policiji, učesnicima ekstremnih borilačkih sportova, a i svima drugima kao nadopuna ili promjena. Pravi funkcionalni trening je najkompletniji način treniranja, jer se radi na svim bitnim sposobnostima, prije svega na snazi, koordinaciji, eksplozivnosti, brzini i izdržljivosti. Moglo bi se reći da je iz svih sportova uzeto ono najefikasnije, te složeno u jedan veoma raznolik koncept.

Sušтина kod svih vježbi je da što više mišića radi istovremeno, a velika većina vježbi najviše pogađa trbuh i donji dio leđa, što su kod većine ljudi najslabije karike u lancu pokreta. Još ako tome pridodamo i minimalni odmor između vježbi, dobijemo vrlo moćno „oruđe“ za sagorijevanje masti i izgradnju mišića.

Core trening ili trening srži tijela kao funkcionalni trening

Danas je poznato da je za svaki jači zamah ili udarac u raznim sportovima potrebno upotrijebiti mišiće centra, odnosno srži tijela, popularno nazvane engleskim nazivom core. Core ili srž tijela predstavlja skup mišića

Until then, the joints most commonly observed in isolation, as well as the muscles that move the joints. Kinetic chains are actually connected joints and muscles that together perform a movement. The complex movement that causes muscle directly in the area of its location and indirectly to the adjacent parts of the body is called the kinetic chain (Mikic et al., 2006).

Many authors give their explanations of what is functional training:

- Many joints activity in several directions, which includes slowing, accelerating and stabilizing with controlled volatility (Gambetta, 1998);
- Second spectrum of activities that enhance the readiness of the body, and are in line with built-in motion (Santana, 2002);
- Third continuum of exercises that include balance and proprioception, performed with feet on the ground without the help of devices. (Boyle, 2003).

Functional training exercise the entire body because the isolation exercises almost no work, and trying to activate as many muscle groups at the same time, and consolidate two basic actions with the body: presses (squats, push-ups...) and withdrawal (chin-ups, including the balance, proprioception, deadlift...). In a relatively short time be working on power, explosiveness, endurance, flexibility, speed and mental components, making it the most complete method of training (Mikic & Basinac, 2012). Functional training based on natural movement, including balance and proprioception.

Djurkovic (2011) stated that functional training most appropriate members of the special army and police forces, participants of extreme martial arts and all others as a supplement or change. The real functional training is the most complete way of training because it works on all relevant factors; strength, fitness, explosiveness, speed and endurance. You could say that of all sports taken what the most effective and complex in a very diverse concept.

It will in all exercises is that the more muscles working simultaneously, a large majority of exercise affects the abdomen and lower back, as with most people weakest link of the chain movement. Even if we add and minimal rest between exercises, we get a very powerful tool for burning fat and building muscle.

Core training or training as a core body functional training

Today we know that for each foothold or shot in various sports need to use the muscles of the center, or core of the body, popularly known as the English name core. Core or core of the body is a set of muscles that

koji sačinjavaju trbušni zid, bočne trbušne mišiće, donji dio leđa te zdjelicu i kuk (Mlinarić, 2012). Ti mišići održavaju tijelo ili dio tijela u stabilnom ravnotežnom položaju da bi se mogao izvesti bilo koji motorički zadatak. U drevnim istočnjačkim učenjima, koja su preuzela bori-lačke vještine, životna snaga (ki ili chi) nalazi se u centru tijela. Taj centar, u borilačkim vještinama nazvan hara, nalazi se nešto ispod pupčanog otvora. Sva snaga i svaki pokret dolazi iz centra (Mikić i sur., 1999).

Vježbanje mišića srži kroz funkcionalni trening zahtijeva prilagođavanje (ne uvijek !) jednoj bitnoj, ali često zaboravljenoj činjenici, mišići srži trebali bi se vježbati u uspravnom, stojećem stavu. Na taj način poboljšava se njihova uloga u stabilizaciji tijela, i održavanju u uspravnom stavu, što je, kako je poznato, jedna od osnovnih uloga tih mišića (Mlinarić, 2012).

METODOLOGIJA ISTRAŽIVANJA

Uzorak ispitanika

Uzorak ispitanika obuhvatio je ukupno 25 ispitanika – trenera, od kojih je 20 ispitanika – trenera muškog pola i 5 ispitanica – trenerica ženskog pola. Uzorak je diferenciran prema spolu, prema stepenu stručne spreme, uzrasnoj kategoriji, godinama radnog staža, godinama rada kod trenutnog poslodavca.

Uzorak varijabli

Varijabla je barem jedno svojstvo ili osobina koje nam pruža mogućnost prepoznavanja nekih internih svojstava entiteta ili barem njegovo razlikovanje od svega ostalog. One su artifičijelni konstrukti uz pomoć kojih, na nekoj dogovorenoj skali vrijednosti, procjenjujemo ta svojstva postojećih objekata tj. entiteta (Bonacin, 2009). Kako bi se što sveobuhvatnije definisale potencijalno zanimljive tvrdnje – mišljenja ispitivanog uzorka ispitanika, konstruisan je anketni upitnik sa ukupno 10 indikatora – pitanja u kojem je svaka tvrdnja označena sa 3 modaliteta i to: u potpunosti se slažem, djelimično se slažem, uopšte se ne slažem.

1. Da li mislite da je funkcionalni trening najefikasniji sistem treninga za vrhunske sportiste i rekreativce ?
2. Da li mislite da funkcionalni trening ima najveću efikasnost pri razvijanju energogenih sistema - aerobnih i anaerobnih sposobnosti ?
3. Da li mislite da se tokom funkcionalnog treninga najviše povećavaju sposobnosti srčano - sudovnog i disajnog sistema ?
4. Da li mislite da se putem rekvizita koji se koriste u funkcionalnom treningu (npr. girja, vreće

make up the abdominal wall, side abdominal muscles, lower back and pelvis and hip (Mlinaric, 2012). These muscles keep the body or body part in a stable equilibrium position to any motor task could. In ancient Eastern teachings, which have taken martial arts, life force (chi or ki) is located in the center of the body. The center, in the martial arts called hara, is located just below the navel. All power and every movement come from the center (Mikić et al., 1999).

Exercising the core muscles through functional training requires adjustment (not always!) Another important but often forgotten fact, the core muscles should be practiced in an upright, standing position. Thereby enhancing their role in the stabilization of the body, and keeping in an upright position, which, as we know, one of the fundamental role of these muscles (Mlinaric, 2012).

RESEARCH METHODOLOGY

The sample

The sample included a total of 25 respondents, of which 20 male and 5 female respondents. Sample is differentiated according to: sex, qualifications, age group, years of service, years of work with the current employer.

The sample of variables

The variable is at least one characteristic or ability that gives us the opportunity to recognize some of the internal properties of entities or at least distinguish it from everything else. They are artificial constructs by which, on an agreed scale of value, the properties of existing objects or entities are being estimated (Bonacin, 2009). In order to comprehensively define potentially interesting statements of the test sample of respondents, the questionnaire is designed with a total of 10 indicators - issues in which each statement is marked with three modalities, namely: completely agree, partially agree, strongly disagree.

1. Do you think that the functional training is the most efficient system of training for top athletes and amateurs?
2. Do you think that functional training has the highest efficiency in the development of aerobic and anaerobic capabilities?
3. Do you think that during the functional training there is the most increase of the abilities of cardio - vascular and respiratory system?
4. Do you think that equipment used in functional training (e.g. kettlebell, sandbags, SAQ ladders and groin, dumbbells) quickly results with the

- s pijeskom, SAQ ljestve i prepone, bučice) brže dolazi do razvoja opšte snage ?
5. Da li mislite da se putem funkcionalnog treninga prije smanjuje višak tjelesnih masnoća i izgrađuje dodatna mišićna masa nego u teretani izolovanim vježbama?
 6. Da li funkcionalni treninga ima više efekta na neuralnom nivou (npr. kod razvoja eksplozivne i maksimalne snage) od ostalih treninga?
 7. Da li je izokinetički trening bolji od izotoničnog treninga za razvoj brzine?
 8. Da li je primarni zadatak funkcionalnog treninga da se sportistu ili rekreativcu omogući što raznovrsnije kretanje s ciljem aktivacije što više mišićnih grupa?
 9. Da li je funkcionalni trening premalo zastupljen u vašem području rada?
 10. Slažete li se da je funkcionalni trening odličan i za rekreativce, a ne samo za vrhunske i profesionalne sportiste?

Opis istraživanja

U cilju dobijanja relevantnih podataka o mogućnostima i efikasnosti funkcionalnog treninga u vrhunskom sportu i rekreaciji provedena je anketa kojom su obuhvaćeni treneri različite starosne kategorije, spola, grane sporta i dužine trenerskog staža.

Anketa na početku sadrži pitanja o spolu, dobi, stručnoj spremi, starosnoj kategoriji i radnom stažu. Glavni sadržaj anketnog upitnika činilo je 10 indikatora – pitanja u kojem je svaka tvrdnja označena sa 3 modaliteta i to: u potpunosti se slažem, djelimično se slažem, uopšte se ne slažem.

REZULTATI I DISKUSIJA

U tabeli 1 prikazan je uzoraj ispitanika diferenciran prema spolu, prema stručnoj spremi, starosnoj dobi, radnom iskustvu i vremenu provedenom na radu kod trenutnog poslodavca. Iz prikazane tabele nije teško uočiti da uzorak ispitanika – trenera u odnosu na pol predstavlja 20 ispitanika-trenera muškog pola i 5 trenera ženskog pola, u odnosu na stepen stručne spremlje 20 ispitanika sa visokom stručnom spremom i 5 ispitanika sa višom stručnom spremom.

U odnosu na starosnu dob 5 ispitanika je u granici od 25 do 35 godina, a 20 ispitanika u dobi od 35 do 45 godina. U odnosu na radni staž 4 ispitanika ima radnog staža između 5 i 10 godina, 20 ispitanika između 10 i 20 godina i 1 ispitanik između 20 i 30 godina. Kod trenutnog poslodavca zaposleni su između 5 i 15 godina.

development of a general power?

5. Do you think that functional training earlier results with reduction of excess body fat and development of additional muscle mass than the gym isolated exercises?
6. Does functional training have more effect on the neural level (e.g. in the development of explosive and maximal strength) than the other trainings?
7. Is isokinetic training better than isotonic training for the speed development?
8. Is it the primary task of functional training to facilitate diverse movement activities to the athletes and recreational sportsmen with the aim of activation as many muscle groups?
9. Is functional training under-represented in your field of work?
10. Do you agree that functional training is excellent for recreational sportsmen and professional athletes?

Description of Research

In order to obtain relevant information about the importance of functional training in top sport and recreation survey was conducted, which included coaches different age groups, gender, branch of sport and sports experience.

The survey begins with a question about sex, age, education level, age group and years of service. The main content of the survey are questions (10 questions) on the effectiveness of training and the types of responses were: completely agree, partially agree, strongly disagree.

RESULTS AND DISCUSSION

Table 1 shows the sample of respondents differentiated by sex, by education, age, work experience and time spent at work with the current employer. From the table below is not difficult to see that the sample of respondents – trainers, in relation to sex, represents 20 male trainers and 5 female coaches, compared to the level of qualifications it is contained of 20 respondents with a university degree and 5 respondents with higher education.

In relation to age, 5 respondents are in the range of 25-35 years, and 20 subjects aged 35-45 years. In relation to the length of service, 4 respondents have work experience between 5 and 10 years, 20 subjects between 10 and 20 years and 1 respondent between 20 and 30 years. With the current employer they have been between 5 and 15 years.

Tabela 1. Uzorak ispitanika

Table 1. Sample

Spol / Sex	Stupanj stručne spreme / Education level	U koju dobnu skupinu pripadate / In the age group you belong to	Koliko imate godina radnog staža / How many have years of service	Koliko godina radite kod trenutnog poslodavca / How many years have you been with your current employer
Muški / Male = (20)	VSS = (20)	25-35 =(5)	5-10 = (4)	5-15 = (25)
Ženski / Female = (5)	VŠS = (5)	35-45 = (20)	10 – 20 = (20)	
			20 – 30 = (1)	

U tabeli 2 prikazana je distribucija mišljenja/tvrdnji (odgovora) na svih 10 pitanja sadržanih u anketnom upitniku (anketi) o značaju, mogućnostima i efikasnosti funkcionalnog treninga u vrhunskom sportu i rekreaciji.

Table 2 shows the results of the survey and analysis of the answers to 10 questions from the questionnaire related to importance, application possibilities and effectiveness of functional training in top sport and recreation.

Tabela 2. Rezultati ankete

Table 2. Poll Results

PITANJA / QUESTIONS	ODGOVORI / ANSWERS					
	U potpunosti se slažem / Strongly agree	%	Djelomično se slažem / Partly agree	%	Uopće se ne slažem / Strongly disagree	%
Da li mislite da je funkcionalni trening najefikasniji sustav treninga za vrhunske sportaše i rekreativce? / Do you think that the functional training is the most efficient system of training for top athletes and amateurs?	20 odgovora / answer	80%	5 odgovora / answer	20%	-	
Da li mislite da funkcionalni trening ima najveću učinkovitost pri razvijanju – energogenih - aerobnih i anaerobnih sposobnosti? / Do you think that functional training has the highest efficiency in the development of aerobic and anaerobic capabilities?	25 odgovora / answer	100%	-		-	
Da li mislite da se tijekom funkcionalnog treninga najviše povećavaju sposobnosti srčano - žilnog i dišnog sustava? / Do you think that during the functional training there is the most increase of the abilities of cardio - vascular and respiratory system?	25 odgovora / answer	100%	-		-	
Da li mislite da se putem rekvizita koji se koriste u funkcionalnom treningu (npr. girja) brže dolazi do razvoja opće snage? / Do you think that equipment used in functional training (e.g. kettlebell) quickly results with the development of a general power?	25 odgovora / answer	100%	-		-	
Da li mislite da se putem funkcionalnog treninga prije smanjuje višak tjelesnih masnoća i izgrađuje dodatna mišićna masa nego u teretani izoliranim vježbama? / Do you think that functional training earlier results with reduction of excess body fat and development of additional muscle mass than the gym isolated exercises?	19 odgovora / answer	76%	6 odgovora / answer	24%	-	
Da li funkcionalni treninga ima više učinka na neuralnoj razini (npr. kod razvoja eksplozivne i maksimalne snage) od ostalih treninga / Does functional training have more effect on the neural level (e.g. in the development of explosive and maximal strength) than the other trainings?	19 odgovora / answer	76%	6 odgovora / answer	24%	-	
Da li je izokinetički trening bolji od izotoničnog treninga za razvoj brzine? / Is isokinetic training better than isotonic training for the speed development?	15 odgovora / answer	60%	10 odgovora / answer	40%	-	
Da li je primarna zadaća funkcionalnog treninga da se sportašu ili rekreativcu omogući što raznovrsnije kretanje s ciljem aktivacije što više mišićnih skupina? / Is it the primary task of functional training to facilitate diverse movement activities to the athletes and recreational sportsmen with the aim of activation as many muscle groups?	24 odgovora / answer	96%	1 odgovor / answer	4%	-	
Da li je funkcionalni trening premalo zastupljen u vašem području rada? / Is functional training under- represented in your field of work?	10 odgovora / answer	40%	7 odgovora	28%	8 odgovora	32%
Slažete li se da je funkcionalni trening odličan i za rekreativce, a ne samo za vrhunske i profesionalne sportaše? Do you agree that functional training is excellent for recreational sportsmen and professional athletes?	25 odgovora / answer	100%	-		-	

Analizirajući rezultate tvrdnji (odgovora) na 1. pitanje, da li mislite da je funkcionalni trening najefikasniji sistem treninga za vrhunske sportiste i rekreativce 20 ili

Analyzing the answers to the first question “Do you think that the functional training is the most efficient system of training for top athletes and amateurs?” 20 train-

80% ispitanika - trenera je odgovorilo u potpunosti se slažem, dok se njih 5 ili 20% odlučilo za tvrdnju djelimično se slažem.

Na 2. pitanje, da li mislite da funkcionalni trening ima najveću efikasnost pri razvijanju aerobnih i anaerobnih sposobnosti, svih 25 ili 100% ispitanika-trenera je odgovorilo da se u potpunosti slaže, a isti takav rezultat je bio u kod trećeg pitanja, da li mislite da se tokom funkcionalnog treninga najviše povećavaju sposobnosti srčano - sudovnog i disajnog sistema.

Svi ispitanici, njih 25 se u potpunosti slažu da primjenom rekvizita koji se koriste u funkcionalnom treningu (npr. girja) brže dolazi do razvoja opšte snage.

Na peto pitanje, da li mislite da se putem funkcionalnog treninga prije smanjuje višak tjelesnih masnoća i izgrađuje dodatna mišićna masa nego u teretani izolovanim vježbama, 19 ili 76% trenera je odgovorilo da se u potpunosti slaže, dok se njih 6 ili 24% djelimično slažu, a isto takvo mišljenje ispitanika je i kod šestog pitanja koji se odnosi na efekte funkcionalnog treninga na neuralnom nivou (npr. kod razvoja maksimalne snage) od ostalih treninga.

Na sedmo pitanje, da li je izokinetički trening bolji od izotoničnog treninga za razvoj brzine, 15 ili 60% ispitanika - trenera je odgovorilo da se u potpunosti se slažu, a 10 ili 40% se djelimično slažu.

Na osmo pitanje, da li se putem funkcionalnih treninga dolazi do većeg razvoja energetske sistema nego kod ostalih treninga, 24 ili 96% ispitanika se u potpunosti slaže, dok je jedan ili 4% ispitanika odabrao odgovor djelimično se slažem.

Deveto pitanje glasilo je, da li je funkcionalni trening premalo zastupljen u vašem području rada. 10 ispitanika ili 40% se u potpunosti slaže, 7 ispitanika ili 28% se djelimično slaže, dok se 8 ispitanika ili 32% uopšte ne slaže sa postavljenom tvrdnjom.

Na pitanje „Slažete li se da je funkcionalni trening odličan i za rekreativce, a ne samo za vrhunske i profesionalne sportiste svih 25 ispitanika ili 100% je odgovorilo da se u potpunosti slaže.

Distribucija odgovora koje su ispitanici dali pokazuje kako su treneri jednoglasni oko činjenice da funkcionalni trening ima najveću efikasnost pri razvijanju energogenih - aerobnih i anaerobnih sposobnosti, te da se tokom funkcionalnog treninga najviše povećavaju sposobnosti srčano - sudovnog i disajnog sistema. Takođe, iz dobijenih rezultata može se konstatovati kako treneri smatraju da funkcionalni trening značajno utiče i na neurogene - sposobnosti eksplozivne i maksimalne snage. Treneri su mišljenja da primjena funkcionalnog treninga najviše utiče na razvoj energogenih(aerobno -anaerobnih sposobnosti) i neural-

ers (80%) responded with “strongly agree”, while 5 of them (20%) decided to claim “partially agree”.

For the second question “*Do you think that functional training has the highest efficiency in the development of aerobic and anaerobic capabilities?*” all 25 trainers (100%) responded “strongly agree”. Identical result was obtained for the third question “*Do you think that during the functional training there is the most increase of the abilities of cardio - vascular and respiratory system?*”

All respondents, 25 of them, “strongly agree” that equipment (e.g. kettlebell) used in functional training quickly results in increase of a general power.

For the fifth question, “*Do you think that functional training earlier results with reduction of excess body fat and development of additional muscle mass than the gym isolated exercises?*” 19 trainers (76%) responded “strongly agree”, while 6 of them (24%) have chosen the claim “partially agree”, and an identical proportion of responses was also for the sixth question, whether functional training has more effect on the neural level (e.g. in the development of maximal and explosive strength) than the other trainings?

Regarding the seventh question “*Is isokinetic training better than isotonic training for the speed development?*” 15 trainers (60%) responded “strongly agree”, and 10 of them (40%) have chosen the claim “partially agree”.

On the eighth question, whether functional training facilitates diverse movement activities to the athletes and recreational sportsmen with the aim of activation as many muscle groups, 24 respondents (96%) “strongly agree”, while one respondent (4%) partially agrees.

The ninth question was “*Is it functional training under-represented in your field of work?*” Results have shown that 10 respondents (40%) “strongly agree”, 7 of them (28%) “partly agree”, while 8 respondents (32%) selected the statement “do not agree”.

To the question “*Do you agree that functional training is excellent for recreational sportsmen and professional athletes?*” all respondents (100%) answered “strongly agree”.

Results show that the coaches are unanimous about the fact that functional training has the highest efficiency in the development of energy - aerobic and anaerobic abilities and that during the functional training, mostly increase the ability of cardio - vascular and respiratory system. It was also noted that trainers agree that functional training significantly affects the neurogenic - explosive and maximum power capability.

nih i neurogenih sistema (razvoj eksplozivne imaksimalne snage).

Takođe, treneri su saglasni i oko toga da se putem rekvizita koji se koriste u funkcionalnom treningu (npr. girja, vodena cijev, bugarska vreća, vlastita težina tijela...) brže dolazi do razvoja opšte snage. Zanimljiva je bila konstatacija kako je funkcionalni trening najefikasniji sistem treninga u vrhunskom sportu i rekreaciji, a da je to upravo tako misli čak 80 % trenera, što nam pokazuje kakvu značajnu ulogu funkcionalni trening ima danas.

Funkcionalni trening sa upotrebom navedenih rekvizita treneri najčešće koriste po principima Crossfita, tj. crossfit treninga nazvanog „Fran“ (Mlinarić, 2012). Osnova takvog pristupa je izvođenje vježbi sa 21 – 15 – 9 ponavljanja s minutom pauze između serija. Vježbe se izvode jedna za drugom (tzv. kružni trening):

- a. objeručni zamah girjom (swing),
- b. sunožni skokovi s vodenom cijevi (slosh pipe) i
- c. klizeći upijač (spraw) s bugarskom vrećom oko vrata (21 ponavljanje, 1 minut odmora, 15 ponavljanja, 1 minut odmora i 9 ponavljanja).

Funkcionalni trening je dobro prošao kod trenera u vezi pitanja oko njegove uloge i doprinosa kod smanjenja viška tjelesne masnoće i izgradnje dodatne mišićne mase u teretani izolovanim vježbama. Treneri su složni da funkcionalni trening ima više efekta na neuralnom nivou, npr. kod razvoja eksplozivne i maksimalne snage, od ostalih treninga. No, treneri su malo podijeljeni u vezi toga da li je izokinetički trening bolji od izotoničnog treninga za razvoj brzine te 60 % njih se u potpunosti slaže s tom tvrdnjom, dok se 40 % trenera djelimično slaže.

Gotovo svi treneri se slažu da je jedan od primarnih zadataka funkcionalnog treninga da se sportisti ili rekreativcu omogući što raznovrsnije kretanje s ciljem aktiviranja što većeg broja mišićnih grupa, dok je preko 30 % trenera naglasilo da funkcionalni trening nije previše zastupljen u njihovom području rada te da bi trebali više koristiti metode funkcionalnog treninga.

Na osnovu ovih konstatacija može se u potpunosti prihvatiti mišljenje da je primarni zadatak funkcionalnog treninga da se sportisti ili rekreativcu omogući što raznovrsnije kretanje s ciljem aktivacije što više mišićnih grupa.

Iz svega navedenoga može se konstatovati da je funkcionalni trening vrlo bitan za trenere i smatra se kako se radi o izuzetno efikasnom sistemu treninga u vrhunskom sportu i rekreaciji koji bi što više trebao biti zastupljen u praksi (Tomljanović i sur., 2011). Njegovu primjenu treba još više promovisati među sportskim trenerima, a osim vrhunskih sportista, funkcionalni trening sve više pažnje dobiva i u rekreativnom sportu. Da je

Also, trainers agree that the equipment used in functional training (e.g. kettlebell, slosh pipe, Bulgarian bags, self-weight...) quickly results with general strength development. Interesting observation was that 80% of trainers agree that functional training is the most effective system of training in top sport and recreation, which shows us what an important role functional training has today.

Functional training, with the use of those props, coaches usually use by the principles of CrossFit, crossfit training called “Fran” (Mlinarić, 2012). The basis of this approach is doing exercises with 21 – 15 - 9 repetitions with a minute of rest between sets. Exercises are performed one after the other (so called circuit training):

- a. Kettlebell (swing)
- a. Jump with both feet with a slosh pipe
- a. Spraw with the Bulgarian bag around neck (21 repetitions, 1 minute rest, 15 repetitions, 1 minute rest i 9 repetitions).

Functional training is well recognized by the trainers regarding questions about its role and contribution in reducing excess body fat and muscle build in the gym isolated exercises. Trainers agree that functional training has more effect on the neural level, for example in the development of explosive and maximum power comparing to other training. Trainers, however, are a bit divided regarding whether the isokinetic training is better than isotonic training in speed development.

Almost all of the coaches agree that one of the primary tasks of functional training is to facilitate diverse movement with the objective of a greater number of muscle groups involvement, while over 30 % of the coach stressed that functional training is not very present in their area of work and should be more used.

On the basis of these statements can be fully accept the view that the primary task of functional training is that to enable athlete or recreational sportsman with diverse movements with the aim of activation of more muscle groups.

From the above, it is clear that functional training is very important for trainers and is considered to be a very efficient system of training in top sport and recreation and should be more represented in practice (Tomljanovic et al., 2011). Its implementation should be further promoted among sports trainers, and besides top athletes, functional training, should get more attention in recreational sport, according to all 25 coaches enrolled in this research.

funkcionalni trening odličan za rekreativce u tome se slaže svih 25 trenera ili 100%.

ZAKLJUČAK

Zanimljivo je naglasiti da je funkcionalni trening kao koncept vježbanja za zdrave ljude proizašao iz rehabilitacijske tehnike pod imenom neuromišićna terapija/trening (NMT), što je zapravo skoro pa identična stvar. Neuromišićni trening u rehabilitaciji se koristi zaredukaciju normalnih obrazaca pokreta kod pacijenta bez obzira da li je riječ o neurološkom ili mišićno-koštanom oštećenju. Ideja je koristiti poznate obrasce pokreta koji aktiviraju više mišićnih grupa odjednom (a samim time i više motoričkih jedinica) tako da se stimulira organizam da razvija snagu, ali i koordinaciju pokreta.

Funkcionalni trening olakšava tijelu svakog čovjeka da se prilagodi svakodnevnim aktivnostima bez obzira da li se radi o njegovom slobodnom vremenu, kada je u svom domu ili na poslu. Kvalitet života automatski postaje bolji, dolazi do većeg zadovoljstva, a obaveze se izvršavaju s lakoćom i puno brže i efikasnije nego što je to bio slučaj kada se ne koristili funkcionalni trening.

Takođe, kod izvođenja vježbi dolazi do jačanja donjeg dijela trbuha, što naposljetku rezultuje stabilizacijom kičmenog stuba i jačanja donjeg dijela leđa. Korist od funkcionalnog treninga imaju osobe koje ne pridaju dovoljno pažnje kretanju, zatim one osobe koje su starije dobi i ne žele u starosti doživjeti atrofiju mišića. Naravno, funkcionalni trening primjenjuju i vrhunski sportisti ili rekreativci. Pored navedenih rekvizita u upitniku (girje, vreće s pijeskom, SAQ ljestve i prepone, bučice,) koji se koriste u funkcionalnom treningu, treba pomenuti i bugarske vreće, medicinke, šipke, suspenzijski trenažeri, indijske palice, konopi, vijače, elastične trake, pliometrijske kutije različitih dimenzija, a tu je naravno i veliki repertoar vježbi koje se izvode samo sa težinom vlastitog tijela. Zanimljiva je i konstatacija trenera da funkcionalni trening ima više efekta na neuralnom nivou, npr. kod razvoja eksplozivne i maksimalne snage, od ostalih treninga.

Izjava autora

Autori pridonijeli jednako.

Konflikt interesa

Mi izjavljujemo da nemamo konflikt interesa.

CONCLUSION

It is interesting to point out that the concept of functional training as the exercise for healthy people derived from the rehabilitation techniques called neuromuscular therapy/training (NMT) which is actually almost identical thing. Neuromuscular training in rehabilitation is used for the re-education of normal movement patterns in patients regardless of whether it is a neurological or musculoskeletal damage. The idea is to use familiar patterns of movement that activates multiple muscle groups at once (and thus more motor units) so that it stimulates the body to develop strength, and coordination.

Functional training facilitates our body to adapt to daily activities regardless of whether they are on our free time, when we are at home or at work. The quality of life we automatically gets better, there is a greater satisfaction and carry out duties with ease and much more quickly and efficiently than was the case when we used functional training.

Also, when performing exercises comes to strengthening the lower abdomen, which ultimately results in the stabilization of the spine and strengthen the lower back. The benefit of functional training is the best for people who do not pay enough attention to the movement and elderly people who do not want to experience muscle atrophy due to their age. Of course, functional training can be applied to top athletes or recreational purposes. Beside the mentioned equipment in the questionnaire (kettlebells, sandbags, SAQ - ladders and groin, dumbbells), that are used for functional training, also Bulgarian bags, medicine balls, rods, suspension trainers, Indian sticks, ropes, rope, elastic bands, plyometric boxes of different dimensions should be mentioned and there is also a large repertoire of exercises to be performed only with the weight of the own body. Also interesting is the observation of trainers included in this research that functional training has more effect on the neural level, for example in the development of explosive and maximum power, comparing to other types of training.

Authorship statement

The authors have contributed equally.

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Kratko saopštenje

Short notice

STATE NUTRITION OF PRE-SCHOOL CHILDREN

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Abstract: The aim of the research was to analyse the state of nutrition in pre-school children. The sample enrolled 325 children, among which 196 boys and 129 girls. There was measuring in May 2015. The data were analysed by descriptive statistics methods and multivariate (MANOVA) variance analyses for $p \leq 0.05$. It was established that boys and girls of pre-school age significantly differ in statistical terms as far as nutrition state is concerned. Univariate (ANOVA) variance analyses pointed to differences also in following variables *Body Mass*, *Ideal Body Mass* and *Body Mass Index* in favor of girls and *Relative Body Mass* in favor of boys. The percentage of undernourished children was extremely high (31.76%), at the same time there were 13.54% of overweight children. 54.70% of children were found to be of normal nutritional status.

Key words: detection, differences, nutrition, pre-school age.

INTRODUCTION

Obesity is a chronic disease revealed through over accumulation of fat tissue in body and weight gain (Gibney, Vorester, & Kok, 2002). Whether a person is obese or not can be established without delay by measuring their actual weight and height and entering details into computer program. Obesity has been on a rise in past 20 years and with the present rise rate it is reaching a global epidemic scale. It has been verified that inactivity can negatively reflect the BMI of pre-school children (Jago et al., 2005). According to information provided by World Health Organisation more than one billion of world population suffers from overweight and three million people are obese (WHO, 2005). Obesity is commonly described as over-accumulation of fat tissue in a body, clinically expressed by Body Mass Index – BMI, but, there are other methods in use (Tsigos et al., 2008). BMI is a number calculated from a child's weight and height (Mei et al., 2002). BMI is a reliable indicator of body fatness for most children and teens. BMI does not measure body fat directly, but research has shown that BMI correlates to direct measures of body fat, such as underwater weighing and dual energy x-ray absorptiometry (DXA) (Freedman et al., 1999). BMI can be considered an alternative for direct measures of body fat. Additionally, BMI is an inexpensive and easy-to-perform method of screening for weight categories that may lead to health problems. For children and teens, BMI is age- and sex-specific and is often referred to as BMI-for-age. After BMI is calculated for children and teens, the BMI number is plotted on the CDC BMI-for-age growth charts (for either girls or boys) to obtain a percentile ranking. Percentiles are the most commonly used indicator to assess the size and growth patterns of individual children in the United States (Must, & Anderson, 2003). The growth charts show the weight status categories used with children and teens (underweight, healthy weight, overweight, and obese) (Whitaker et al., 1997).

BMI-for-age weight status categories and the corresponding percentiles are shown in the following table.

Table 1. Percentile range of BMI status

Weight Status Category	Percentile Range
Underweight	Less than the 5th percentile
Healthy weight	5th percentile to less than the 85th percentile
Overweight	85th to less than the 95th percentile
Obese	Equal to or greater than the 95th percentile

BMI is used as a screening tool to identify possible weight problems for children. American Academy of Pediatrics (AAP) recommend the use of BMI to screen for overweight and obesity in children beginning at 2 years old. For children, BMI is used to screen for obesity, overweight, healthy weight, or underweight (Ferraro, Thorpe, & Wilkinson, 2003). However, BMI is not a diagnostic tool. For example, a child may have a high BMI for age and sex, but to determine if excess fat is a problem, a provider would need to perform further assessments. These assessments might include skin fold thickness measurements, evaluations of diet, physical activity, family history, and other appropriate health screenings. Although the BMI number is calculated the same way for children and adults, the criteria used to interpret the meaning of the BMI number for children and teens are different from those used for adults. For children and teens, BMI age- and sex-specific percentiles are used for two reasons:

- The amount of body fat changes with age.
- The amount of body fat differs between girls and boys.

The energy consumption and specific levels of physical activity may have greater influence to body composition in early childhood (Atkin, & Davies, 2000). Among children who were obese at the age of 7 (ITM>95. percentile) 43% of girls and 63% of boys remain obese at the age of thirty (Pover, Lake, & Cole, 1997). In Serbia 54% of population are overweight with highest prevalence in Vojvodina where 34.5% are overweight and 23% obese (Grujić et al., 2005). In view of higher frequency of obese children, the aim of this paper was to establish the nourishment state of pre-school children in Belgrade, and also to determine the quantitative analyses of differences between boys and girls of pre-school age.

MATERIALS AND METHODS

The sample was selected from pre-school children population of both genders from Belgrade municipality. The children, aged 5 to 6, were attending preschool The 11th of April in Novi Beograd and were from different social backgrounds.

The sample consisted of 325 children, among which 196 boys 97 (5 year olds) and 66 (6 year olds) and 129 girls 99 (5 year olds) and 63 (6 year olds). Assessment included anthropometric dimensions of the measurement of one variable for the evaluation of longitudinal dimensionality of the skeleton 1) *Body Height* and one variable for assessing the volume and mass of the body 2) *Body Weight* to the respect of the international biological program IBP for each measure. Based on these two dimensions measured are calculated and made an ideal body weight (IBW) for boys and for girls IBW down your formula 3) *Ideal Body Weight* (kg); continues to be obtained relative body weight (RBW) on the basis that the body weight is distributed with the received ideal body weight and multiplied by 100 4) *Relative body weight* (%), in the end BMI is obtained by dividing the body weight divided by the squared body height 5) *Body Mass Index* (kg/m²).

$$\text{Ideal Body Mass for boys} - (\mathbf{IBM}) = \mathbf{BH-100} - (\mathbf{BH-150})/4 + (\mathbf{Y-20})/4$$

$$\text{Ideal Body Mass for girls} - (\mathbf{IBM}) = \mathbf{BH-100} - (\mathbf{BH-150})/2.5 + (\mathbf{Y-20})/4$$

Key: BH – Body Height; Y – Life time.

$$\text{Relative body weight} - (\mathbf{RBM}) = \mathbf{BW/IBM*100}$$

Key: BW – Body Weight; IBM – Ideal Body Mass.

$$\text{Body mass index} - (\mathbf{BMI}) = \mathbf{BW/(BH)^2}$$

Key: BW – Body Weight; BH – Body Height.

For classification of nourishment level Harison's classification cited by (Kristiforović-Ilić, 2004).

Table 2. Categorization nutritional status

Score BMI	kg/m ²
Body mass index	category
<16	severe under nutrition
16-16,9	central under nutrition
17-18,4	moderate under nutrition

18,5-24,9	normal scope of nutrition
25-29,9	overweight
30-39,9	obesity
>40	morbid obesity

The descriptive statistics of body composition variables have been calculated for the arithmetic mean (M) and standard deviation (S), while the application of the multivariate (MANOVA) and univariate (ANOVA) analysis provided the statistically significant differences between respondent groups formed on the basis of sexually dimorphic differences.

RESULTS

Analyses of descriptive statistics (table 1) pointed to homogeneity of male and female sub-sample subjects only for the skeleton length variable, *Body Height*, while increased differences have been noticed in other variables. Such results are consequence of disproportional development of children, the fact that body weight is influenced by not only genetics but furthermore by socio-economical factors, way of living and level of physical activity.

Based on multivariate variance analyses significant differences in nutrition state of pre-school boys and girls were established. By individual analyses statistically significant differences were verified for variables *Body Weight*, *Ideal Body Weight* and *Body Mass Index* in favor of girls and *Relative Body Mass* in favor of boys. Comparing the two sub-samples the average normal level of nutrition is evident, as concluded based on BMI, while based on RTM the normal level of nutrition can be assumed in case of boys and underweight in case of girls. Such results point to well balanced diet that corresponds to the needs of pre-school children and a satisfactory degree of physical activity of children of opposite sex. In the view of ITM values it can be concluded that subjects from both sub-samples are deficient in *Ideal Body Mass*, in average about 4 kilograms.

Table 3. Descriptive Statistics and Differences

Variable	Boys (N=196)		Girls (N=129)		f	p
	M(AS)	SD(S)	M(AS)	SD(S)		
Body Height (mm)	1187.81	64.28	1183.77	66.23	0.30	0.58
Body Weight (kg)	28.07	5.01	30.10	4.93	12.89	0.00
Ideal Body Mass (kg)	32.21	4.75	34.65	3.91	7.86	0.01
Relative Body Mass (%)	94.61	19.77	87.75	16.14	10.80	0.00
Body Mass Index (kg/m ²)	19.97	3.64	21.63	3.94	15.03	0.00

$$F=24,501; P=0,000$$

Key: AS – arithmetic mean; S – standard deviation; f – unvaried f test; p – level of statistical significance of f test; F – multivariate Wilks' F test; P – statistical significance of multivariate F test.

For the purpose of easier understanding of the results at the index of nutrition the *Body Mass Index* was sorted by sex. Three classifications were taken into consideration: underweight, normal and overweight.

Table 4. The Distribution of BMI by Sex

Body Mass Index	Boys (N=196)		Girls (N=129)		Total (N=325)	
	n	%	n	%	n	%
<30 (<18,5 kg/m ²) Underweight	75	38.27	28	21.71	103	31.76
30-85 (18,5-24,9 kg/m ²) Normal	99	50.51	79	61.24	178	54.70
>85(>25 kg/m ²) Overweight	22	11.22	22	17.05	44	13.54
Total	196	100	129	100	325	100

The results presented in table 2 point out to a high percentage of children with low body mass, undernourished (38.27% of boys and 21.71% of girls which makes total of 103 children). Normal body mass values were found in 178 subjects (99 boys and 79 girls), and overweight were 22 boys and 44 girls, a total of 13.54%.

CONCLUSION

The most significant factors for setting off of obesity are believed to be genetic and metabolic factors, unhealthy living accompanied by diet inapt to body needs food high in energy value. The children of pre-school age suffer more often from overweight and obesity than undernourishment (Silveira et al., 2013). There should also be mentioned socio-cultural, psychological and neuroendocrine factors (high level of cortisole, lower levels of thyroid gland hormones, growth hormone deficiency and others). The main risk factors for obesity are: genetics 50-70%; intake of excessive calories and ill-assorted food (basic carbohydrates combined with concentrated fats or protein); insufficient physical activity (70%) (Eveleth, & Tanner, 1990).

The diversity of nutrition status of preschool children was explored on a sample of 325 subjects. The research pointed out to a remarkably high percentage of undernourished children within sample group (31.76%), while the percentage of overweight children is 13.54%. Normal nutrition level was found in 54.07% of sample. It is obvious that general overweight prevalence of 13.54% is still fairly low compared to countries of Western Europe and USA (Yajnik, 2000). As far as Eastern Europe is concerned contrasting results were noted in Georgia (Kherkheulidze et al., 2010). The general prevalence of malnutrition was 31.76%, but this is beyond the study and nearly half are obtained Markovic et al., (2008), who found that in one part of Serbia (Šumadija), 17.7% of children were malnourished.

By applying adequate formulas to software of modern apparatus quick and precise insight into the nourishment state of children was made possible. Today the best results of children's body composition assessment and physical development monitoring are achieved by the new technology such as Bioelectrical Impedance (BIA) (Goran et al., 1993). The large number of factors that influence obesity in children has been recognized and divided into several groups: feeding habits, physical (in) activity (length of physical activity during a day, type of activity, hours of sleep), factors related to parents (obesity of mother or both parents, mother's weight during the pregnancy, mother's smoking habits during the pregnancy, education level of family, family size and others) as well as factors related to the educational institutions (Jovanović et al., 2010; Pelemiš et al., 2014).

The results of multivariate variance analyses indicated significantly different levels of nourishment status of gender dimorphic pre-school age sample subjects from Belgrade. Both sub-samples were noted for aberration from ideal body mass, in average about 4.1 kg (boys) and 4.5 kg (girls). Biological, psychological and sociological factors are important in development and state of nutrition of children. This result corresponds with the findings of research conducted by Western authors who have established that information on bodily composition are used very often but they also recognized existing gap in standards and an extensive lack of understanding of problems related to *Body Mass Index* (Meyer et al., 2010). Namely, it has been established that children who train sport have increased levels of continuous and acute energy loss of weight. The research results are in accordance with the results of nourishment state, that is to say the constitution affiliation, gained in AP Vodvodina (Republic of Serbia) which is defined by the undernourishment state followed by associated values which point to weak physical constitution (Vasić, & Jakonić, 2009). The results of this study have pointed out the evident underweight of pre-school children of both sexes. There is a small number of overweight children but it can not be expected that such trend will continue at later stages of their life. Prevention of underweight should include increase of physical activity, reduction of energy intake, adjustment of factors rooted in environment that influence body mass and also parental education.

Considering that results of severe weight disorders treatments, especially overweight and underweight, are by and large unsatisfactory, most authors agree that prevention should take lead (Koplan, Liverman, & Kraak, 2004; Goldman et al., 2004). We would like to add that early detection, monitoring and supporting, not only the children, but a family as a whole, to change the life style, level of physical activity and the diet quality may provide an answer.

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Statement

The authors have equally contributed to the paper.

Conflict of interest

We declare there is not conflict of interest between authors.

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STANJE UHRANJENOSTI PREDŠKOLSKE DECE

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Abstrakt: Cilj istraživanja bio je analizirati stanje uhranjenosti kod dece predškolskog uzrasta. Uzorak je sačinjavalo 325 dece, među kojima je 196 dečaka i 129 devojčica. Merenje je vršeno u maju 2015. godine. Podaci su analizirani deskriptivnom statistikom, te metodama multivarijantne (MANOVA) analize varijanse na nivou $p \leq 0.05$. Utvrđeno je da se dečaci i devojčice predškolskog uzrasta značajno razlikuju kada je stanje uhranjenosti u pitanju. Univarijantna (ANOVA) analiza varijanse ukazuje na razlike ispoljene u sledećim varijablama *Telesna masa*, *Idealna telesna masa* i *Indeks uhranjenosti* u korist devojčica i *Relativna telesna masa* u korist dečaka. Postotak pothranjene dece je izuzetno visok (31,76%), u isto vreme bilo je 13,54% dece sa prekomernom telesnom težinom, a 54,70% dece je bilo normalne uhranjenosti.

Ključne reči: detekcija, razlike, uhranjenost, predškolska deca.

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Kratko saopštenje

Short notice

LATENTNA STRUKTURA INDIKATORA ZA PROCJENU OSOBINA TRENERA MLADIH SPORTISTA

LATENT STRUCTURE INDICATORS FOR ASSESSING FEATRES OF YOUNG SPORTSMEN COACHES

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Apstrakt: Istraživanje je provedeno na uzorku od ukupno 121 ispitanika – sportiste uzrasta 14 – 16 godina iz pet različitih sportova (smučanje, boks, plivanje, odbojka i košarka), putem anketnog upitnika koji sadrži 19 reprezentativnih indikatora – osobina, koje bi trener trebalo da posjeduje. Ispitani su stavovi mladih i perspektivnih sportista o poželjnim osobinama dobrog trenera. Radi se o selektovanim mladim i perspektivnim sportistima, čiji je kvalitet utvrđen na osnovu ostvarenih sportskih rezultata na zvaničnim prvenstvima Republike Srpske, Bosne i Hercegovine i međunarodnim takmičenjima. U istraživanju je primijenjen anketni upitnik u kojem svaka tvrdnja ima 5 odgovora i to: uvijek, često, povremeno, rijetko i nikad. Radi se o petostepenoj Likertovoj skali. Anketa sadrži i pitanja koja se odnose na pol, dužinu trenažnog staža i vrstu sporta. Osnovni cilj istraživanja bio je utvrđivanje latentne strukture indikatora za procjenu osobina trenera mladih i perspektivnih sportista. U cilju utvrđivanja latentne strukture primijenjenih indikatora primijenjena je faktorska analiza s rotacijom u Varimax soluciji. Dobijeni rezultati faktorske analize s rotacijom u Varimax soluciji pokazali su stabilan skup od četiri izolovane latentne dimenzije koje se mogu opisati kao: (1) stručni kvaliteti trenera (2) opšte ljudske osobine trenera (3) spoljašnje osobine trenera i (4) odnos trenera prema sportistima. Rezultati ukazuju na činjenicu da su osobine koje trener posjeduje i ispoljava u radu sa mladim i perspektivnim sportistima na treningu i takmičenju od izuzetnog značaja za formiranje cjelokupne i svestrane ličnosti mladog sportiste u njegovom sportskom napredovanju.

Ključne riječi: osobine trenera, mladi sportisti, anketa, faktorska analiza.

Uvod

Sport kao masovna društvena pojava, odnosno njegova primjena najbolje je vidljiva u zastupljenosti kod djece i mladih. Nesumnjivo je da sport pored škole i po-

Abstract: Research was conducted on a sample of 121 respondents in total-sportsmen aged 14-16 years old from five different sports (skiing, boxing, swimming, volleyball and basketball), through a questionnaire containing 19 representative indicators – qualities that the coach should possess. Examined are the attitudes of young and promising sportsmen of the desirable characteristics of a good coach. It's about the selected young and promising sportsmen, whose quality is determined on the basis of achieved results at official championships in of Republic of Srpska, Bosnia and Herzegovina and international competitions. The survey questionnaire was administered in which any claim has 5 replies as follows: always, often, sometimes, rarely did I ever. It's about five-point Liker scale. The survey contains questions related to gender, length of training period and type of sport. In order to determine the latent structure of the appropriateness of indicators was used factor analysis with Varimax rotation in solution. Given results of the factor analysis with Varimax rotation in solutions showed stable set of four isolated latent dimensions that can be described as: (1) technical quality of the trainers (2) the general human traits coaches (3) external characteristics of trainers and (4) the ratio of coaches to the sportsmen. The results point to the fact that the qualities that a coach has to exhibit the work of young and promising sportsmen in training and competition is of great importance for the formation of the whole personality and versatile young sportsmen in his sport promotion.

Keywords: features of the trainer, young sportsmen, survey, factor analysis.

INTRODUCTION

Sport as a mass social phenomenon, and its use is best seen in the representation of children and young people. There is no doubt that sport by the school and the family significantly affects the formation of psychophysi-

rodice značajno utiče na formiranje psihofizičkih karakteristika ličnosti mladih sportista, odnosno njihovih moralnih i socijalnih obilježja. U formiranju ličnosti mladih sportista ključnu ulogu ima trener, odnosno njegov odnos prema sportistima, te posjedovanje i ispoljavanje poželjnih osobina. Kompleksna dinamika trenera i sportista sa kojima rade je, između ostaloga, pod uticajem njihovih osobina ličnosti (Jowett i sar., 2005). Prema Ćirkoviću i saradnicima (2010), trener je inicijator i realizator programa treninga, stalni kontrolor angažovanja sportiste na treninzima i takmičenjima – ‘stalno dežurno uho i oko’. Višedecenijska empirijska i naučna istraživanja potvrđuju da trener ima nemjerljiv značaj u formiranju ličnosti mladog sportiste. Trener ne samo da djeluje na sportski razvoj mladog sportiste, već se njegovo djelovanje odražava i na ostale aspekte djetetovog života (Smoll i Smith, 1989). Od osobina ličnosti koje posjeduje trener i koje ispoljava u radu sa mladim sportistima zavisi i nivo njihove identifikacije sa trenerom. Istraživanja sprovedena u SAD pokazuju da se oko 20 miliona djece starosti do 14 godina bavi nekim sportom, ali da čak troje od četvero djece koje se počinje baviti sportom u dobi 6 – 7 godina, od njega odustaje ulaskom u pubertet ili najkasnije do 15 godine (Papalia i sar., 1999).

Postoji veliki broj klasifikacija osobina trenera, ali ne postoji potpuna saglasnost koje su to najvažnije i najpoželjnije osobine trenera. Savremeni trener mora raspolagati dobrim teorijskim i praktičnim znanjem, kao i visokim moralnim vrijednostima. Svakodnevno ponašanje na treningu, takmičenju, ugled koji uživa u društvu, te karakterne osobine koje posjeduju utiču na formiranje stavova i ponašanje mladih sportista. Važno je da trener umije da prilagodi verbalno izražavanje uzrastu djeteta i da je upoznat sa osnovama razvoja djece u predškolskom uzrastu (Smiljanić, 1991; Pijaže, 1977). Tepavčević (2009) u svojoj studiji o poželjnim osobinama trenera izdvaja četiri faktora: kreativnost, harizmatičnost, komunikativnost i nametljivost. Demonstracija sigurnosti i odlučnosti se očekuje od trenera u prisustvu sportiste, a posebno se kao poželjna osobina trenera izdvaja pravičnost (Ivanović, 2016).

Bezbroj novih situacija postoji na takmičenju, a iste bi trener trebao uspješno rješavati da bi došao do željenog cilja (Kovač, M. i Kovač, J., 2007). Trener u radu sa mladim sportistima, u interpersonalnim odnosima utiče na razvijanje njihovih moralnih vrijednosti, socijalizaciju ličnosti, te formiranje radnih navika, radne discipline i odgovornosti. Lee i sar., (1993) pokazali su da mladi sportisti veliku važnost pridaju interesu trenera za njih kao ličnosti. Jasnim definisanjem pravila ponašanja na

cal personality of young sportsmen, and their moral and social characteristics. In the formation of the personality of young sportsmen coach has a key role, and his attitude towards the sportsmen, and the possession and expression of desirable traits. The complex dynamics of coaches and sportsmen with whom they work, among other things, influenced by their personality traits (Jowett et al., 2005). According to Ćirkovic and associates (2010), coach is the initiator and implementer of training programs, continuous controller engaging athletes in training and competition - ‘continuous-duty ear and eye’. Decades of empirical and scientific research confirms that the coach has immeasurable significance in the formation of the personality of the young athletes. Coach not only affects the sports development of young sportsmen, but its activity reflected in other aspects of the child’s life (Smoll and Smith, 1989). From a personality trait that has a coach and that manifests itself in working with young sportsmen depends on the level of their identification with the coach.

Surveys conducted in the United States show that about 20 million children aged under 14 engaged in some sport, or even three of the four children who are starting to play sports at age 6-7 years, than he gives up puberty or later than 15 years (Papalia et al., 1999). There are many classifications of coach characteristics but there is no complete agreement what are the most important and most desirable traits of the coaches. The modern coach must have good theoretical and practical knowledge, as well as high moral values. Everyday behavior in training, competition, reputation it enjoys in society, and character traits that have influenced the formation of attitudes and behavior of young sportsmen. It is important that the coach knows how to adjust the verbal expression of the age of the child and that he is familiar with the basics of the development of children in preschool age (Smiljanic, 1991; Piaget, 1977). Tepavčević (2009) in his study of the desirable characteristics of a coach identifies four factors: creativity, charisma, communication skills and assertiveness. The demonstration of safety and commitment is expected from the coach in the presence of athletes, especially as a desirable trait coach stands out justice (Ivanović, 2016).

Countless new situation there is a competition, and the same would coach should be tackled in order to reach the desired goal (Kovač, M., & Kovač, J., 2007). The coach working with young athletes, in interpersonal relationships affect the development of their moral values, socialization of personality, and the formation of work habits, work discipline and responsibility. Lee et al., (1993) have shown that young athletes attach great importance to the interests of coaches for them as individuals. By clearly defining the

treningu i takmičenju i isticanjem fair – playa, trener utiče na formiranje moralnih vrijednosti, koje prije svega zavise od ličnog primjera dosljednosti, odgovornosti, poštenja i pravednosti. Kroz sistem nagrađivanja i kazni, trener potvrđuje svoja moralna načela i na taj način predstavlja poželjna moralna ponašanja. Prema Vasti i sar., (1997), najnepoželjnija metoda u radu sa mladim sportistima je pokazivanje moći, putem naredbe, prijetnje ili primjene sile, a najpoželjnija metoda u radu sa mladim sportistima je indukcija, odnosno razgovor kojim se mladom sportisti ukazuje na mogućnost posljedica ili štete koje njegovi postupci mogu izazvati.

Uvažavanjem primjedbi i mišljenja sportista, te podsticanju kolektivnog rada i ostvarivanja zajedničkih ciljeva djeluje na smanjivanje unutargrupnog suparništva. Veoma je bitno da trener izgradi pozitivan odnos povjerenja trener – sportista, da je ljubazan, duhovit, društven... Trener koji zanemari važnost odnosa sportista – trener na proces vođenja treninga direktno rizikuje razvoj sportskih potencijala (Lyle, 1999). Takođe, za trenera je veoma bitno da na treninzima stvari treba rješavati na demokratski način, ali postoje situacije u kojima je neophodno da trener preuzima odgovornost i autoritet u donošenju odluka. Treninzi ne smiju biti loše organizovani, trener mora biti stručan i ne smije praviti razlike među sportistima. Veliki broj sportskih psihologa naglašava značaj optimalnog odnosa između trenera i sportiste (Jowett i Cockerill, 2003; Jowett i Ntoumanis, 2004; Poczwardowski i sar., 2006).

Savremeni sport ne trpi improvizacije. Poštovanje reda, rada i discipline dio su sportskog sistema od kojeg zavisi uspjeh u sportu i trajanje sportske karijere. Kroz primjenu odgovarajućih pravila ponašanja i sistem rada u sportskoj organizaciji, te ličnim primjerom trenera, omogućava se razvoj individualnih kvaliteta i osobina sportiste ali i veća predanost grupi i kolektivna odgovornost. Prema Jowettu i Clark – Carteru (2006), odnos sportiste i trenera ima veliki psihološki uticaj za razvoj i stabilnost osoba uključenih u taj odnos.

Cilj ovog rada je istraživanje poželjnih osobina trenera koje je neophodno da trener posjeduje ili da ih razvija i primjenjuje u radu sa mladim i perspektivnim sportistima, a koje značajno utiču na bavljenje sportom i trajanje sportske karijere.

rules of conduct in training and competition, and emphasis on fair - play, coach influences the formation of moral values, which primarily depend on the personal example of consistency, responsibility, integrity and fairness. Through a system of rewards and penalties, the coach confirmed his moral principles and is thus a desirable moral behavior. According to Vasti et al., (1997), the least desirable method of working with young sportsmen is able to show, through orders, threats or use of force and the preferred method of working with young sportsmen is the induction or counseling to young sportsmen indicating the possibility or consequences damages actions can cause.

Respecting the comments and opinions of athletes and fostering collective work and achievement of common goals operates at reducing intergroup conflicts. It is very important that the coach builds a positive relationship of trust coach – sportsmen that is kind, humorous, sociable... Coach who ignores the importance of the relationship of sportsmen- coach in the process of training management is directly risking the development of sports resources (Lyle, 1999). Also, for the coach it is very important that the training actually be solved in a democratic way, but there are situations where it is necessary that the coach takes responsibility and authority to make decisions. Trainings should not be poorly organized, the coach must be competent and must not make distinctions among sportsmen. A large number of sports psychologists emphasizes the importance of optimal relationship between coach and sportsmen (Jowett and Cockerill, 2003; Jowett and Ntoumanis, 2004; Poczwardowski et al., 2006).

Modern sport does not tolerate improvisation. Respect for the order, work and discipline are part of the sports system, which depends on success in sports and duration sports career. Through the application of appropriate rules of conduct and system of work in the sports organizations, and personal example of trainers, allows the development of individual qualities and characteristics of sportsmen but also greater commitment to the group and collective responsibility. According Jowett and Clark - Carter (2006), the ratio of sportsmen and coaches has a great psychological impact on development and stability of the people involved in the relationship.

The aim of this study is to investigate desirable traits coaches that it is imperative that the coach possesses or that it develops and applies in working with young and promising sportsmen and are important in sports and duration sports career.

METOD RADA

Uzorak ispitanika

Uzorak ispitanika sačinjavali su perspektivni sportisti Republike Srpske, učesnici "Ljetne škole sporta Republike Srpske 2015", ukupno njih 121 sportista, iz pet sportova i to: smučanje, boks, plivanje, odbojka i košarka. Radi se o selektovanim mladim i perspektivnim sportistima, čiji je kvalitet utvrđen na osnovu ostvarenih sportskih rezultata na zvaničnim prvenstvima Republike Srpske, Bosne i Hercegovine i međunarodnim takmičenjima. Starost ispitanika je bila od 14 do 16 godina.

Uzorak varijabli

Mjerni instrument bila je anketa koja sadrži 19 reprezentativnih osobina koje bi trener mladih sportista trebao da posjeduje. Anketa za procjenu stavova je validirana i ranije korištena (Chelladurai i Saleh, 1980; Radovanović, 1997), a ista je konstruisana po modelu Likertove skale pri čemu je svaka tvrdnja označena sa pet modaliteta (uvijek, često, povremeno, rijetko i nikad). Anketa obuhvata ukupno 19 indikatora koji obuhvataju sljedeće tvrdnje: (1) ljubazan, (2) veseo, (3) prirodan, (4) društven, (5) duhovit, (6) pošten, (7) inteligentan, (8) marljiv, (9) skroman, (10) pravedan, (11) dosljedan, (12) nepristrasan, (13) stručan, (14) štiti naš interes, (15) dobar predavač, (16) entuzijasta, (17) svestran, (18) dobre fizičke kondicije, (19) uredan.

Pored pitanja za procjenu poželjnih osobina dobrog trenera, anketa sadrži pitanja koja se odnose na pol, trenajni staž i vrstu sporta.

Obrada podataka

Za utvrđivanje stavova/tvrdnji ispitivanih sportista o poželjnim osobinama trenera korištena je petostepena skala Likertovog tipa gdje za svaku tvrdnju postoji pet odgovora: uvijek, često, povremeno, rijetko, nikad. Rezultati istraživanja su obrađeni postupcima deskriptivne statistike, gdje su za svaku varijablu izračunati osnovni centralni i disperzioni parametri:

- Aritmetička sredina (Mean),
- Minimalni rezultat (Minimum),
- Maksimalni rezultat (Maksimum) i
- Standardna devijacija (Std Deviation).

Za utvrđivanje latentne strukture stavova/tvrdnji ispitanika primijenjena je faktorska analiza s rotacijom u Varimax soluciji.

REZULTATI I DISKUSIJA

U Tabeli 1 prikazani su osnovni statistički parametri stavova ispitanika o poželjnim osobinama trenera. Iz Ta-

METHOD OF WORK

The examiner sample

The sample consisted of promising sportsmen of the Republic of Srpska, participants of "Summer School of Sport of the Republic of Srpska in 2015", a total of 121 athletes from five sports including: skiing, boxing, swimming, volleyball and basketball. These are selected young and promising sportsmen, whose quality is determined on the basis of achieved results at official championships in Republic of Srpska, Bosnia and Herzegovina and international competitions. Age was 14-16 years.

Pattern variables

The measuring instrument was a questionnaire which contains 19 representative traits that coach of young sportsmen should possess. Survey to assess attitudes is validated and previously used in similar studies (Chelladurai and Saleh 1980, Radovanovic, 1997) and is constructed on the model of Likert scale where each statement is marked by five modalities (always, often, sometimes, rarely, never). The survey covers a total of 19 indicators covering the following statements: (1) polite, (2) a cheerful, (3) natural, (4) social, (5) witty, (6) fair, (7) intelligent, (8) a diligent, (9) modes, (10) just (11) consistent, (12) an impartial, (13) professional, (14) protects our interests, (15) a good speaker, (16) enthusiasts, (17) is a versatile, (18) good physical condition, (19) in order. In addition to questions for assessment of desirable qualities of a good coach, the survey contains questions related to gender, training internship and type of sport.

Data processing

To determine the attitudes / claims tested sportsmen on the desired characteristics of trainers a five-point Likert scale was used, where for each claim there are five answer: always, often, sometimes, rarely, never. Survey results were analyzed using descriptive statistical methods, where for each variable to calculate the basic central and dispersion parameters:

- Arithmetic environment (Mean)
- Minimum score (Minimum)
- Maximum score (maximum) and
- Standard deviation (Std Deviation).

To determine the latent structure of attitudes/claims of the respondents applied the factor analysis with Varimax rotation in solution.

RESULTS AND DISCUSSION

Table 1 shows the basic statistical parameters of respondent's attitude on the desired characteristics of the

bele 1 se vidi da je istraživani kontekst stavova ispitanika prema poželjnim osobinama trenera pokazao da ispitanici generalno iskazuju pozitivan stav prema osobinama trenera. Iskazane vrijednosti pojedinačnih stavova kreću se u granicama od 1 (minimalne) do 5 (maksimalne) za većinu indikatora izuzev indikatora 2, 6, 11 i 15 čije se minimalne vrijednosti razlikuju od jedinice. Srednje vrijednosti primijenjenih indikatora kreću se u rasponu od 2.79 do 5.00. Iskazane vrijednosti stavova ispitivanog uzorka mladih sportista ipak pokazuje njihovu pozitivnu usmjerenost srednjeg intenziteta (4.51). U intenzitetu stava značajno se ističu sljedeći indikatori: uredan (4.81), prirodan (4.73), društven (4.72), pošten (4.69), stručan (4.65), inteligentan (4.64) i dobar predavač (4.63). Vrijednosti ostalih indikatora su nešto manjeg intenziteta, ali takođe značajni i pozitivno orjentisani.

Tabela 1. Osnovni statistički parametri stavova (indikatora) ispitanika

	N	Minimum	Maximum	Mean	Std. Error	Std. Deviation
P1	121	1	5	4.55	.070	.774
P2	121	2	5	4.40	.072	.790
P3	121	1	5	4.73	.062	.683
P4	121	2	5	4.72	.060	.661
P5	121	1	5	4.34	.096	1.053
P6	121	2	5	4.69	.065	.719
P7	121	1	5	4.64	.070	.773
P8	121	1	5	4.53	.081	.895
P9	121	1	5	4.36	.097	1.063
P10	121	1	5	4.50	.081	.896
P11	121	2	5	4.50	.078	.858
P12	121	1	5	4.05	.111	1.224
P13	121	1	5	4.65	.072	.793
P14	121	1	5	4.50	.085	.932
P15	121	2	5	4.63	.074	.818
P16	121	1	5	4.39	.088	.969
P17	121	1	5	4.54	.078	.857
P18	121	1	5	4.35	.098	1.078
P19	121	1	5	4.81	.061	.675
ukupno / Total Mean	121	2.79	5.00	4.51	.052	.552

Legend/Legenda: N – broj ispitanika; **Minimum** – minimalni rezultat mjerenja; **Maximum** – maksimalni rezultat mjerenja; **Mean** – aritmetička sredina; **Std. Deviation** – Standardna devijacija

coach. From Table 1 we can see that the context investigated the attitudes of respondents to the desirable characteristics of coaches showed that respondents generally expressed a positive attitude towards the characteristics of a coach. The carrying amounts of the individual attitudes ranged from 1 (minimum) to 5 (maximum) for most indicators except for indicators 2, 6, 11 and 15 whose minimum values differ from unit. Mean values of indicators applied are in the range of **2.79 to 5.00**. The carrying amount of the attitudes of the test sample of young athletes still shows their positive orientation of medium intensity (4.51). In the intensity of attitude significantly the following indicators are highlighting: Neat (4.81), natural (4.73) social (4.72), honest (4.69), professional (4.65), intelligent (4.64) and a good teacher (4.63). Values of other indicators were somewhat lower intensity, but also significant and positively oriented.

Table 1. Basic statistical parameters of attitudes (indicators) pts

Legend / Legend: N - number of respondents; **Minimum** - the minimum measurement result; **Maximum** - the maximum measurement result; **Mean** - mean; **Std. Deviation** - Standard deviation

Tabela 2. Osnovni statistički parametri stavova (indikatora) ispitanika prikazanih u totalu

Statistics		
Total Mean		
N	Valid	121
	Missing	0
Mean		4,5189
Std. Error of Mean		,05023
Std. Deviation		,55252
Skewness		-1,261
Std. Error of Skewness		,220
Kurtosis		,940
Std. Error of Kurtosis		,437
Minimum		2,79
Maximum		5,00

Table 2. Basic statistical parameters of attitudes (indicators) of respondents indicated in total

Legend/Legenda: N – broj ispitanika; Mean – aritmetička sredina; Std. Error of Mean – standardna greška aritmetičke sredine; Std. Deviation – Standardna devijacija; Skewness – mjera asimetrije; Kurtosis – mjera izduženosti; Minimum – minimalni rezultat mjerenja; Maximum – maksimalni rezultat mjerenja;

Faktorska analiza je opravdana s obzirom na to da su vrijednosti KMO koeficijenta 0.844, a Bartlett-ovog testa 1151.969 (df 171) na nivou značajnosti 0.00. Za utvrđivanje strukture primijenjenih indikatora primijenjena je faktorska analiza s rotacijom u Varimax soluciji. Proračunom karakteristične jednačine matrice interkorelacija izračunati su karakteristični korjenovi i karakteristični vektori te matrice.

Analizom rezultata zadržane su one glavne komponente čiji su karakteristični korjenovi zadovoljili Gutman – Kaiserov kriterij koji obuhvata sve karakteristične korjene čije su vrijednosti veće ili jednake jedinici.

Utvrđivanje latentne strukture primijenjenih indikatora koji ukazuju na poželjne osobine trenera definisano je rotacijom inicijalnog koordinatnog sistema manifestnih varijabli primjenom Varimax solucije (Kaiser, 1958).

U Tabeli 3 prikazani su karakteristični korjenovi i objašnjeni dijelovi zajedničke varijanse primijenjenih indikatora.

Faktorizacijom matrice interkorelacije indikatora i primjenom Gutman – Kaiserovog kriterija dobijena su četiri karakteristična korijena (četiri latentne dimenzije) koje objašnjavaju ukupno 62 % zajedničke varijanse. Pojedinačni doprinos u objašnjenju zajedničke varijanse iznosi za prvu latentnu dimenziju 41 %, za drugu 8 %, za treću 7 % i za četvrtu 6 %. Kao što se vidi najveći dio zajedničke varijanse nosi prva glavna latentna dimenzija.

Legend / Legend: N - number of respondents; Mean - mean; Std. Error of Mean - standard error of the mean; Std. Deviation - Standard deviation; Skewness - a measure of asymmetry; Kurtosis - a measure of elongation; Minimum - the minimum measurement result; Maximum - the maximum measurement result;

Factor analysis is valid, flowing the results of KMO coefficient 0.844, and Bartlett's test 1151.969 (df 171), with the significant value of 0.00.

For determining the structure of the appropriateness of indicators was used factor analysis with Varimax rotation in solution. Budget characteristic equation intercorrelation matrix to calculate the characteristic roots and characteristic vectors of this matrix.

The analysis results are retained one of the main components of which are the characteristic roots meet Gutman - Kaiser criterion which includes all the characteristic roots whose values are greater than or equal to one.

Establishing the latent structure of applied indicators showing the desirable traits coach is defined by rotation of the coordinate system of initial manifest variables using the Varimax solution (Kaiser, 1958).

Table 3 shows the characteristic roots and explained parts of common variance indicators applied. Intercorrelation matrix factorization and applying indicators Gutman - Kaiser criterion were obtained four characteristic roots (four latent dimensions) that explain a total of 62% of common variance. The individual contribution to the explanation of the common variance is the first latent dimension of 41% for second 8% for the third 7% and 6% for the fourth. As seen most of the common variance carries the first main latent dimensions.

Tabela 3. Karakteristični korjenovi i objašnjeni dijelovi zajedničke varijance

Table 3. The characteristic roots and explained parts of common variance

Component	Total Variance Explained					
	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	7.823	41.171	41.171	7.823	41.171	41.171
2	1.480	7.789	48.960	1.480	7.789	48.960
3	1.357	7.144	56.104	1.357	7.144	56.104
4	1.151	6.060	62.164	1.151	6.060	62.164
5	.995	5.237	67.401			
6	.894	4.704	72.105			
7	.776	4.087	76.192			
8	.699	3.679	79.871			
9	.636	3.345	83.216			
10	.550	2.893	86.109			
11	.459	2.417	88.526			
12	.421	2.216	90.743			
13	.390	2.055	92.797			
14	.340	1.787	94.584			
15	.298	1.570	96.154			
16	.238	1.251	97.405			
17	.211	1.112	98.517			
18	.144	.756	99.273			
19	.138	.727	100.000			

U Tabeli 4 prikazana je matrica izolovanih glavnih komponenti sa rotacijom u Varimax soluciji. Analizom matrice izolovanih glavnih komponenti (Tabela 4), u kojima su iznijeti koeficijenti matrice glavnih komponenti (korelacije vektora manifestnih varijabli sa izolovanim glavnim komponentama), tj. koordinate vektora varijabli projektovanih na ortogonalni sistem latentnih dimenzija, koje se definišu kao glavne komponente, mogu se uočiti četiri izolovane glavne komponente.

Iz prikazane matrice može se uočiti da najveće ortogonalne projekcije vektora manifestnih varijabli na prvu glavnu komponentu imaju indikatori koji govore o stručnim kvalitetima trenera i to: dobar predavač 0.82, stručan 0.76, entuzijast 0.67, štiti interese 0.63, marljiv 0.54, inteligentan 0.54 i svestran 0.53. S obzirom na visoke i dominantne projekcije indikatora stručnosti prvi izolovani faktor se može opisati - definisati kao *faktor stručnih kvaliteta trenera*.

Prvi faktor se odnosi na stručne kvalitete trenera. Očita je jaka uloga stručnosti trenera u edukaciji i usvajanju sportsko – tehničkih znanja mladih sportista. Očito je kako u populaciji ispitivanog uzorka sportista postoji svijest o stručnom vođenju koje daje mogućnost boljeg usvajanja sportsko – tehničkih znanja i postizanje sportskih rezultata. Sportsko – tehnička znanja koje sportisti dobijaju od takvih trenera pružaju koristi za opštu dobit, a stručnost garantuje uspjeh u takmičenju.

Najznačajnije ortogonalne projekcije vektora ma-

Table 4 shows the matrix of isolated main components with Varimax rotation in solution. The analysis of the main components of the matrix isolated (Table 4) that outline the main components of the coefficients of the matrix (correlation vector manifest variables with isolated major components), ie. coordinates of the vector of variables to the projected dimension of the latent orthogonal system, which are defined as the main components could be identified by four insulated main components. From the presented matrix it can be seen that the largest orthogonal projection vector of manifest variables on the first principal component are indicators that speak of the professional qualities of trainers, namely: a good teacher 0.82, an expert 0.76, 0.67 enthusiast, protect the interests of 0.63, 0.54 industrious, intelligent 0.54 and versatile 0.53. Due to the high and dominant projections of expertise indicators first isolated factor can be described - defined as the quality factor of professional trainers. The first factor relates to the quality of coaches. There is an obvious strong role of trainer expertise in education and adoption sports - technical knowledge of young sportsmen. It is obvious how in the population of the test sample sportsmen there is awareness of professional conduct which gives the possibility of adopting a better sports - technical knowledge and achieve results in sport. Sports - technical knowledge that sportsmen receive from such coaches provide benefits to the general profit and expertise will guarantee success in the competition.

nifestnih varijabli na drugi faktor imaju indikatori koji se odnose na opšte ljudske i karakterne osobine trenera: društven 0.76, veseo 0.74, duhovit 0.72, ljubazan 0.64 i prirodan 0.44, pa se drugi faktor može opisati - definisati kao *faktor opštih ljudskih osobina*. Vidljivo je da mladi sportisti posjeduju svijest o potrebi opštih ljudskih osobina trenera.

Najznačajnije ortogonalne projekcije vektora manifestnih varijabli na treći faktor imaju indikatori koji se odnose na spoljašnje osobine ličnosti trenera i to: pošten 0.73, pravedan 0.71, visok nivo fizičke kondicije 0.69 i uredan 0.58, pa se treći faktor može definisati kao *faktor spoljašnjih osobina trenera*. Takođe je vidljivo da kod ispitanika postoji svijest o važnosti i drugih osobina trenera koje su povezane sa opšte ljudskim osobinama.

Najznačajnije ortogonalne projekcije vektora manifestnih varijabli na četvrti faktor imaju indikatori koji se odnose na pristup trenera prema sportistima kao što su: nepristrasan 0.77, skroman 0.67 i dosljedan 0.59, pa se četvrti faktor može definisati kao *faktor odnosa trenera prema sportistima*. Ovako dobijeni rezultati ukazuju na poželjne osobine trenera od kojih zasigurno zavisi formiranje svestrane i zdrave ličnosti mladih i perspektivnih sportista u njihovom sportskom napredovanju.

Ako se dobijeni rezultati ovog istraživanja uporede sa nekim dosadašnjim istraživanjima, može se zaključiti da su dobijeni rezultati u okvirima očekivanih rezultata (Tepavčević, 2009; Ivanović, 2016). Cetinić i Kajtna (2009) ističu potrebu dobre komunikacije učenika sa profesorom fizičkog vaspitanja, kao i objektivnost i primjenu individualizacije, pohvalu i povjerenje profesora. Svijest o potrebi ispravnog odnosa trenera sa mladim sportistima unutar sportske organizacije je vrlo jasna; očito je poznato kako dobar odnos doprinosi boljem i efikasnijem radu, donošenju boljih rješenja kao i dobra i slika o takvom istinskom treneru koji svoja znanja uspješno prenosi na mlade podstičući ih na veće zalaganje i postizanje boljih rezultata.

The most significant orthogonal projection of vector manifest variables to another factor have the indicators relating to the general human character traits and coaches, 0.76 sociable, cheerful 0.74 0.72 witty, affectionate 0.64 and natural 0.44, while the second factor can be described - defined as the factor of universal human traits. It is evident that young sportsmen have the awareness of the need for universal human trait coach.

The most significant orthogonal projection of vector manifest variables to the third factor have the indicators relating to external traits and coaches to: fair 0.73, just 0.71, a high level of physical fitness is 0.69 and tidy 0.58, and the third factor can be defined as a factor external features of the coach. It is also evident that among the respondents there is awareness of importance of other characteristics in which coaches are associated with common human traits.

The most significant orthogonal projection of manifest variables vector on the fourth factor in the indicators relating to access to the athletes, coaches, such as: 0.77 impartial, and consistent with a modest 0.67 was 0.59, while the fourth factor can be defined as a factor of relationship coaches to the athletes. Thus obtained results indicate the desirable traits of coaches on which certainly depends the formation of a comprehensive and healthy personality of young and perspective sportsmen in their sports promotion.

If the given results of this study twist with some previous research, it can be concluded that the results are in the terms of expected results (Tepavčević, 2009; Ivanović, 2016). Cetinić and Kajtna (2009) emphasize the need for good communication students with a professor of physical education, as well as objectivity and application of individualization, praise and trust of the professor. Awareness of the need for a right relationship between coach and young sportsmen within the sport organization is very clear, obviously it is known that a good relationship contributes to a better and more effective work, making better decisions and good and true picture of such a coach to successfully transmit their knowledge to young people by encouraging them to greater commitment and better results.

Tabela 4. Komponentna matrica rotirana u Varimax soluciji

Table 4. Component Matrix Varimax rotated Solutions

	Rotated Component Matrix ^a			
	Component			
	1	2	3	4
P15	,817			
P13	,760			
P16	,670			
P14	,613			
P8	,544			
P7	,543			
P17	,526			
P4		,759		
P2		,737		
P5		,719		
P1		,635		
P3		,441		
P6			,729	
P10			,709	
P18			,686	
P19			,578	
P12				,765
P9				,670
P11				,587

ZAKLJUČAK

Istraživanje je provedeno na uzorku od ukupno 121 ispitanika – sportiste uzrasta 14-16 godina iz pet različitih sportova (smučanje, boks, plivanje, odbojka i košarka), sa ciljem utvrđivanja latentne strukture indikatora za procjenu osobina trenera mladih i perspektivnih sportista. U cilju utvrđivanja latentne strukture primijenjenih indikatora primijenjena je faktorska analiza s rotacijom u Varimax soluciji. Dobijeni rezultati faktorske analize s rotacijom u Varimax soluciji pokazali su stabilan skup od četiri izolovane latentne dimenzije koje se mogu opisati-definisati kao: (1) *stručni kvaliteti trenera* (2) *opšte ljudske osobine trenera* (3) *spoljašnje osobine trenera* i (4) *odnos trenera prema sportistima*.

Rezultati istraživanja generalno ukazuju da mladi sportisti uključeni u različite sportove imaju pozitivno orjentisane stavove kada su u pitanju poželjne osobine njihovih trenera.

Rezultati takođe, ukazuje na činjenicu da su osobine koje trener posjeduje i ispoljava u radu sa mladim i perspektivnim sportistima na treningu i takmičenju od izuzetnog značaja za formiranje cjelokupne i svestrane ličnosti mladog sportiste u njegovom sportskom napredovanju.

Izjava autora

Autori pridonijeli jednako.

Konflikt interesa

Mi izjavljujemo da nemamo konflikt interesa.

CONCLUSION

The study was conducted on a sample of 121 respondents - sportsmen aged 14-16 from five different sports (skiing, boxing, swimming, volleyball and basketball), in order to determine the latent structure of indicators for assessing the properties of trainers of young and promising sportsmen. In order to determine the latent structure of the appropriateness of indicators was used factor analysis with Varimax rotation in solution. The results of the factor analysis with Varimax rotation in solutions showed stable set of four isolated latent dimensions that can be described as: (1) *technical quality of the trainers* (2) *the general human traits coaches* (3) *external characteristics of trainers and* (4) *the ratio of coaches to the sportsmen*.

Research results generally indicate that young sportsmen involved in different sports have a positive attitude oriented when it comes to desirable traits of their coach.

The results also point to the fact that the qualities that a coach has demonstrated in working with young and promising sportsmen in training and competition is of great importance for the formation of the whole personality and versatile young athletes in his sport promotion.

Authorship statement

The authors have contributed equally.

Financial disclosure

We declare that we have no conflicts of interest.

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