

BAZIČNE ANTROPOMETRIJSKE I MOTORIČKE RAZLIKE KOD 14 GODIŠNJIH UČENIKA SA RAZLIČITIM NIVOIMA KARDIORESPIRATORNE IZDRŽLJIVOSTI

BASIC ANTHROPOMETRIC AND MOTOR DIFFERENCES IN 14 YEARS OLD MALE PUPILS WITH DIFFERENT CARDIO RESPIRATORY ENDURANCE LEVEL

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Summary

The aim of this study is determination of cardio-respiratory endurance level and its influence on the manifestation of certain anthropometric and motor differences in 14 years old male pupils. The main sample contains 156 fourteen year (+ 0.5 year) old male pupils from 15 primary schools from all urban and rural regions in the Republic of Macedonia. For the prediction of cardio respiratory endurance level multistage 20 meters shuttle run test was used (20SRT). According to the success in 20SRT test, using k-means clustering method, there were established three (N/Z-scores means) maximum distinguish groups with low (52/-1.112), average (66/.126) and high (38/1.304) level of cardio respiratory endurance. The anthropometric parameters triceps skin fold thickness, body height, body weight, and body mass index (BMI), as well as 5 motor tests from battery EUROFIT for children (bent arm hang, sit-ups, standing broad jump, shuttle run 10x5 and hand grip dynamometry) were used in the study. The inter-groups differences in all analyzed anthropometric and motor manifestations were obtained with statistical method ANOVA. The obtained results of the study show significant inter-groups differences [$F(df1,2) = 2.174; p < .05$] in all analyzed variables, except in variables body height and hand grip dynamometry, which indicate that, in this period of adolescence, better level of cardio-respiratory endurance generates higher level in analyzed components of physical fitness and lower level of fat body mass.

Key Words: pupils, groups, endurance, anthropometric, motor, differences.

Introduction

Physical education (PE) is that phase of education, which aims through a balanced and coherent range of physical

Sažetak

Cilj ove studije je utvrđivanje nivoa kardiorespiratorne izdržljivosti i definisanje njenog uticaja na manifestaciju razlika u određenim antropometrijskim merama i motoričkim sposobnostima kod 14-godišnjih učenika. Uzorak sačinjavaju 156 učenika, starih 14 godina (+ 0,5 godina) iz 15 osnovnih škola u raznim urbanim i ruralnim regijama u Republici Makedoniji. Predikcija nivoa kardiorespiratorne izdržljivosti je utvrđena primenom testa višestepenog progresivnog trčanja na 20 metra (20SRT). Na osnovu uspeha u testu 20SRT, koristeći k-means metod taksonomizacije, utvrđene su tri maksimalno različite grupe (N/prosečne Z-vrednosti) koji imaju niski (52/-1,112), prosečni (66/.126) i visoki (38/1,304) nivo kardiorespiratorne izdržljivosti. U ovoj studiji su primenjene antropometrijske mere kožni nabor tricepsa, telesna visina, telesna masa i bodi mas indeks (BMI), kao i 5 motoričkih testova iz baterije EUROFIT za decu (izdržaj u zgibu, podizanje trupa, skok u dalj, trčanje 10x5 metara i dinamometrija šake). Međugrupne razlike u svim analiziranim antropometrijskim i motoričkim manifestacijama su utvrđene primenom statističke metode ANOVA. Dobijeni rezultati pokazuju signifikantne međugrupne razlike [$F(df1,2) = 2,174; p < 0,05$] u svim analiziranim varijablama, osim u varijablama telesna visina i dinamometrija šake, što znači da u ovom periodu adolescencije, veći nivo kardiorespiratorne izdržljivosti generira veći nivo analiziranih motoričkih sposobnosti i niži nivo telesne mase i masne komponente tela.

Cljučne riječi: učenici, grupe, izdržljivost, antropometrijske, motoričke, razlike.

Uvod

Fizičko vaspitanje (FV) je ona faza obrazovanja individue, koja ima za cilj da pomoću adekvatnih fizičkih aktivnosti

activities to contribute to the optimum development of an individual's potential including growth and development, physical and psycho-social competencies (Hardman, 2007). The core element of physically educated person despite the level of competence in range of necessary movement skills is also the values of physical fitness (motor abilities) (California Department of Education, 1994).

In many national PE curriculums in the world (British Columbia, California, England, Slovenia, Alberta, Alabama etc.), it is noted that one of the main tasks of PE is the development of student's motor abilities (Klinčarov, 2007a).

The results from researching the thematic objectives in the PE curriculums in the EU show that 15% from the school curriculums in the primary and in the secondary schools have as a target the importance of the PE in the development of the health-related physical fitness (Hardman, 2007).

The subject-matter of monitoring and of evaluating students' motor performances, i.e. the students' physical status, within the physical education teaching process in the developed educational systems, is precisely defined and regulated. In the European countries the founding of a unified European system for monitoring and for evaluating students' physical status within the physical education teaching process started several decades ago. As a result of these tendencies the Eurofit battery for children has been constructed. This battery consists of several simply measurable tests for monitoring and for evaluation student's motor performances. In this battery several other simple measurements for monitoring and for evaluation of students' basic anthropometric parameters are also included (Council of Europe, Committee for the Development of Sport, 1988). In USA, the Fitnessgram battery of tests is recommended by the American National Physical Education and Sport Association as the national battery of tests (The Cooper Institute for Aerobics Research, 1999), which is also consisted of several easily measurable and simple tests for evaluating student's basic motor and morphological manifestations.

The long-term and continuous monitoring of the changes that occur during the manifestation of certain motor qualities allows identification of optimal ways for intervention in increasing students' physical activity and in strengthening the physical education teaching process. The long-term longitudinal studies which are conducted on a national level and which refer on the monitoring of students' physical status occur in several European countries such as Slovenia (Strel et al., 1997), and the Czech Republic (Rychtecky, 2008).

Recently, a major research within the HELENA (Healthy Lifestyle in Europe by Nutrition in Adolescence) project has been conducted for identification of normative values for evaluation and for correct interpretation of the level of adolescents' basic motor abilities, within the European countries (Ortega et al., 2010).

In the Republic of Macedonia there is no unified national system for monitoring and for evaluation of student's motor performances. The positive experiences in Europe and worldwide should be the basis for creating a simple national battery of tests through which the changes in student's motor performances in the Republic of Macedonia can be valorized in the future (Klinčarov, 2007b).

In the physical education teaching process, the evaluation i.e. the defining of the level of students' physical characteristics and capabilities is one of the primary conditions for implementation of certain educational subject-matters. Depending on the degree of manifestation of certain qualities there should be a prediction and a realization of such adjusted

doprinese optimalnom razvoju potencijala individue, uključujući rast i razvoj, fizičke i psihosocijalne kompetencije (Hardman, 2007).

Glavni elemenat fizički edukovane osobe, osim nivoa kompetentnosti u određenom broju kretnih vještina, je i vrednovanje motoričkih sposobnosti (California Department of Education, 1994).

U velikom broju nacionalnih kurikuluma u FV širom sveta (Britanska Kolumbija, Kalifornija, Engleska, Slovenija, Alberta, Alabama itd.), kao jedan od glavnih zadataka FV se navodi razvoj motoričkih sposobnosti učenika (Klinčarov, 2007a). Dobijeni rezultati ispitivanja tematskih ciljeva u kurikulumima u FV u EU, pokazuju da oko 15% školskih kurikuluma u osnovnim i srednjim školama targetira važnost FV u razvoju zdravstveno usmerenih motoričkih sposobnosti (Hardman, 2007).

Tematika praćenja i ocenjivanja motoričkih performansi učenika, odnosno fizički status učenika, u sklopu nastave fizičkog vaspitanja u razvijenim obrazovnim sistemima je precizno defisana i regulisana. Pre nekoliko decenija je na nivou evropskih zemalja započeto sa radom na ustanovljavanju unificiranog evropskog sistema za praćenje i ocenjivanje fizičkog statusa učenika u sklopu nastave fizičkog vaspitanja. Kao rezultat ovih tendencija konstruisana je baterija Eurofit za decu, koja sadrži nekoliko jednostavno merljivih testova za praćenje i ocenjivanje motoričkih performansi učenika. U ovu bateriju je implementirano isto tako i nekoliko jednostavnih testova za praćenje i ocenjivanje bazičnih antropometrijskih parametara kod učenika (Council of Europe, Committee for the Development of Sport, 1988). U SAD, kao nacionalna baterija testova preporučena od Američke nacionalne asocijacije za fizičko vaspitanje i sport, je ustanovljena baterija testova Fitnessgram (The Cooper Institute for Aerobics Research, 1999), koja je isto tako sastavljena od nekoliko lako merljivih i jednostavnih testova za procenu bazičnih motoričkih i morfoloških manifestacija učenika.

Dugoročno i kontinuirano praćenje promena koje nastaju manifestacijom određenih motoričkih kvaliteta omogućava da se iznađu optimalni načini za intervenciju u pravcu povećanja fizičke aktivnosti kod učenika i jačanja obrazovnog procesa u fizičkom vaspitanju. Dugogodišnje longitudinalne studije sprovede na nacionalnom nivou, koje se odnose na praćenje fizičkog statusa učenika se sreću u nekim evropskim zemljama kao što su Slovenija (Strel i saradnici, 1997) i Češka (Rychtecky, 2008).

Sa ciljem da se napravi uvid u vrednosti testiranja bazičnih motoričkih sposobnosti učenika na nivou evropskih zemalja, sprovedno je veliko istraživanje u sklopu programa HELENA, sa ciljem iznalaženja normativnih vrednosti za evaluaciju i korektnu interpretaciju nivoa bazičnih motoričkih sposobnosti adolescenata (Ortega i saradnici, 2010).

U Republici Makedoniji još uvek ne postoji unificirani nacionalni sistem za praćenje i ocenjivanje motoričkih sposobnosti učenika. Pozitivna iskustva Evrope, a i šire, treba da predstavljaju osnovu za kreaciju jednostavne nacionalne baterije testova, pomoću koje će se perspektivno moći da valorizuju promene u delu motoričkih sposobnosti učenika u Republici Makedoniji (Klinčarov, 2007b).

U nastavi predmeta fizičko i zdravstveno vaspitanje, procena, odnosno definisanje nivoa fizičkih karakteristika i sposobnosti učenika predstavlja jedan od primarnih preduslova za implementaciju adekvatnih nastavnih sadržaja. U zavisnosti od stepena manifestacije individualnih kvaliteta, potrebno je da se predvide i realizuju takvi prilagođeni nastavni

educational contents that will have an optimal effect. Physical education didactics experts (Anastasovski, et al., 2000; Findak, 2003; Matić, 1978; etc.), point out that through evaluation of certain segments in students' physical status should be achieved an inspection of students' capabilities and capacities and on the basis of the realistic indicators that students manifest should be achieved differentiated (individualized) approach in the realization of the teaching process.

The capability evaluation of the cardio respiratory system of pupil's organism and the monitoring of its developmental changes is a great field of interest, because it is directly connected to the individuals' health status (Malina et al., 2004).

Working with students, in the physical education system, should be directed for increasing of the pupil's cardio respiratory endurance abilities.

In this study we analyzed the differences in basic morphological and motor manifestations in 14 year old male pupils' that have different cardio respiratory endurance level in order to achieve indication of the possible cardio respiratory endurance interdependences with the other segments of pupils' physical status.

The results of this study are in function for identification of the optimal model for monitoring and evaluation of students' physical status in the Republic of Macedonia.

Methods

Entity sample

The entity sample in this research is taken from a population of 14 year old male students in the Republic of Macedonia ($M = 14,00$; $SD = .29$) and there are 156 students from 15 primary schools from all regions from the Republic of Macedonia. The sample is proportionally defined on state allocation of students in urban and rural environments. All students regularly attended the physical education classes.

Variables sample

The basic anthropometric measures: body height (HAIGHT), body weight (WEIGHT) and triceps skin fold thickness (TSF), was measured among all students. The body mass index (BMI) was calculated as the quotient of the body weight given in kilograms divided with the body height given in square meters ($\text{Weight kg/Height m}^2$).

The level of cardio respiratory endurance was evaluated through the multistage progressive 20 meters shuttle run test (20SRT).

In this research, for the evaluation of the other motor performances of students, 5 motor tests from the EUROFIT battery for children were applied. For prediction of the functional strength (hand and shoulder muscle endurance) we used Bent Arm Hang test (BAH). For evaluation of the repetitive strength of the body (abdominal muscle endurance) we used the 30 seconds sit-ups test. (SUP). For evaluation of the explosive strength we used the Standing broad jump test (SBJ). For evaluation of agility (speed and coordination) we used Shuttle run 10x5 meters test (SHR), while for evaluation of the maximal strength we used the test Hand grip dynamometry (HGR).

sadržaji koji će imati optimalan efekat. Stručnjaci u oblasti metodike fizičkog vaspitanja (Anastasovski i saradnici, 2000; Findak, 2003; Matić, 1978; i dr.) ističu da procenom posebnih segmenata morfološkog i motoričkog statusa učenika treba da se napravi uvid u mogućnosti i kapacitete učenika i na osnovu realnih pokazatelja koje manifestuju učenici, da se pristupi diferenciranom (individualnom) pristupu u samoj realizaciji nastave.

Evaluacija sposobnosti kardiorespiratornog sistema dečjeg organizma i praćenje njegovih razvojnih promena, predstavlja oblast od posebnog interesa, budući da je direktno povezana sa zdravstvenim statusom individue (Malina i sardnici, 2004).

Rad sa učenicima u sistemu fizičkog vaspitanja treba da je u pravcu poboljšanja kardiorespiratornih kvaliteta dečijeg organizma.

Sa ciljem da se ukaže na moguće interzavisnosti kardiorespiratorne izdržljivosti sa ostalim segmentima fizičkog statusa dečjeg oraganizma, u ovom radu je izvršena analiza razlika u osnovnim morfološkim i motoričkim manifestacijama kod učenika muškog pola 14-godišnjeg uzrasta sa različitim nivoom kardiorespiratorne izdržljivosti.

Rezultati ove studije su u funkciji iznalaženja optimalnog modela za praćenje i ocenjivanje fizičkog statusa učenika u Republici Makedoniji.

Metode rada

Uzorak ispitanika

Uzorak ispitanika u ovom istraživanju je izvučen iz populacije 14-godišnjih učenika Republike Makedonije ($M = 14,00$; $SD = 0,29$) muškog pola i iznosi ukupno 156 učenika iz 15 osnovnih škola iz svih regiona Republike Makedonije. Uzorak je definisan proporcionalno državnoj raspoređenosti učenika u urbanim i ruralnim sredinama. Svi učenici redovno posećuju nastavu fizičkog vaspitanja.

Uzorak varijabli

Kod svih učenika su izmerene bazične antropometrijske mere telesna visina (HEIGHT), telesna težina (WEIGHT) i kožni nabor tricepsa (TSF). Bodi mas indeks (BMI) je izračunat kao količnik telesne težine izražene u kilogramima podeljene sa telesnom visinom izražene u metrima ($\text{Weight kg/Height m}^2$).

Nivo kardiorespiratorne izdržljivosti je procenjen preko testa višestepeno progresivno dugotrajno trčanje na 20 metara (20SRT).

Za procenu ostalih motoričkih performansi učenika u istraživanju je primenjeno 5 motoričkih testova iz baterije EUROFIT za decu. Za predikciju funkcionalne snage (mišićna izdržljivost ruku i ramenog pojasa) je korišćen test izdržaj u zgibu na vratilu (BAH). Za procenu repetitivne snage trupa (abdominalna mišićna izdržljivost) je korišćen test podizanje trupa za 30 sek. (SUP). Za procenu eksplozivne snage je primenjen test skok u dalj iz mesta (SBJ), dok je za procenu agilnosti (brzina i koordinacija) primenjen test trčanje 10x5 metara (SHR), a za procenu maksimalne snage je primenjen test dinamometrija šake (HGR).

Testing procedure

Students were measured during physical education classes by a previously trained team of experts. All measurements were realized by the same team according to previously defined plan for organization of the measurements. All parameters were measured according to the given recommendations in the Eurofit tests for children Manuel (Council of Europe, Committee for the Development of Sport, 1988).

Statistic analysis

Data analysis was conducted using several statistic procedures in the statistic package Statistica 5.0.

Original values in 20SRT test in all analyzed subjects were transformed in normalized Z-scores. Furthermore, by applying cluster analysis (K-means clustering) the main sample was divided into three sub samples which were defined as maximally distinctive groups (clusters) with low, medium and high level of cardio respiratory endurance.

At the end, by applying of Anova statistic procedure and the Post hoc comparisons (LSD tests - Last significant differences tests) the univariate intergroup differences of all analyzed anthropometric and motor variables between the three groups of subjects with different level of cardio respiratory endurance were defined. The significance level was set on $p = .05$.

Results

On the basis of the applied cluster analysis the total entity sample was divided in 1. group with low level (G1) of cardio respiratory endurance consisted of 52 subjects ($M = -1.11245$; $SD = .405026$), 2. group with medium (average) level (G2) consisted of 66 subjects ($M = .12574$; $SD = .340933$), and 3. group with high level (G3) of cardio respiratory endurance consisted of 38 subjects ($M = 1.30391$; $SD = .495290$), (Table 1).

Tabela 1: Aritmetičke sredine (M) i standardne devijacije (SD) u testu 20SRT kod tri grupe ispitanika sa različitim nivoom kardiorespiratorne izdržljivosti

Table 1: Means (M) and standard deviations (SD) in the variable 20SRT in all groups of subjects with different level of cardio respiratory endurance

	M	SD	N
G1	-1.11245	.405026	52
G2	.12574	.340933	66
G3	1.30391	.495290	38
All Groups	.00000	1.000000	156

Legend/Legenda: G - Group (Grupa); M - Means (Aritmetička sredina); SD - Standard deviation (Standardna devijacija); N - Number of respondents (Broj ispitanika).

In Table 2 are presented the results from the applied univariate analysis with which the intergroup differences in the analyzed anthropometric and motor manifestations are defined.

Statistically significant univariate intergroup differences in certain anthropological parameters were identified in following variables: body weight [$F(df1,2) 2.153 = 5.464$; $p = .000$], triceps skin fold thickness [$F(df1,2) 2.173 = 39.611$; $p = .000$] and body mass index [$F(df1,2) 2.173 = 14.498$; $p = .000$]. Results from this analysis indicate important

Procedure testiranja

Učenci su izmereni za vreme časova fizičkog vaspitanja od strane prethodno obučene ekipe merioca. Sva merenja su realizovana sa istim timom merioca po unapred pripremljenom planu za organizaciju merenja. Svi parametri su izmereni po preporukama datim u priručniku Eurofit za decu (Council of Europe, Committee for the Development of Sport, 1988).

Statistička analiza

Podaci su obrađeni nizom statističkih postupaka u statističkom paketu Statistica 5.0.

U obradi podataka izmerene vrednosti u testu 20SR kod svih analiziranih ispitanika su prvo transformisane u normalizovane Z-skorove. Nakon toga je primenom taksonomske analize (K-means clustering) osnovni uzorak ispitanika podeljen na tri subuzorka koji su definisani kao maksimalno distinktna grupa (taksoni) sa niskim, srednjim i visokim nivoom kardiorespiratorne izdržljivosti. Na kraju su primenom statističkog postupka Anova i Post Hoc komparacijom (LSD testovi - Last significant differences tests) utvrđene univarijantne međugrupne razlike u svim analiziranim antropometrijskim parametrima i motoričkim varijablama između tri grupe ispitanika sa različitim nivoom kardiorespiratorne izdržljivosti. Nivo značajnosti postavljen je na $p = 0,05$.

Rezultati

Na osnovu primenjene taksonomske analize ukupnog uzorka ispitanika, u grupi sa niskim nivoom kardiorespiratorne izdržljivosti grupisano je ukupno 52 ispitanika ($M = -1,11245$; $SD = 0,405026$), u grupi sa srednjim (prosečnim) nivoom je izdvojeno 66 ispitanika ($M = 0,12574$; $SD = 0,340933$), dok je grupu sa visokim nivoom kardiorespiratorne izdržljivosti sačinjavalo 38 ispitanika ($M = 1,30391$; $SD = 0,495290$), (Tabela 1).

Tabela 1: Aritmetičke sredine (M) i standardne devijacije (SD) u testu 20SRT kod tri grupe ispitanika sa različitim nivoom kardiorespiratorne izdržljivosti

morphological influences on the cardio respiratory endurance of adolescents in this age group.

As far as the results of the applied univariate analysis of variance in the analyzed motor abilities are concerned, we came to significant intergroup differences [$F(df1,2) 2,174; p < .05$], between the groups with different level of cardio respiratory endurance in all analyzed motor variables except in the variable hand grip dynamometry.

procenu kardiorespiratorne izdržljivosti učenika ovog uzrasta.

Što se tiče rezultata primenjene univarijantne analize varijanse u analiziranim varijablama za procenu motoričkih sposobnosti, dobijene su signifikantne međugrupne razlike [$F(df1,2) 2,174; p < 0,05$], između grupa sa različitim nivoom kardiorespiratorne izdržljivosti u svim analiziranim motoričkim varijablama, osim u varijabli dinamometrija šake.

Tabela 2: Univarijantne razlike između grupa sa niskim (G1), prosečnim (G2), i visokim (G3) nivoom manifestacije u testu 20SRT

Table 2: Univariate differences between groups with low (G1), medium (G2) and high (G3) level of manifestations in the 20SRT test

		M	M sq Effect	M sq Error	F(df1,2) 2.153	p
BH	G1	163.3019				
	G2	164.3530	83	71.30	1.1682	.313673
	G3	166.0526				
BW	G1	60.30769				
	G2	53.75000	742	135.81	5.4645	.005102
	G3	53.78947				
TSF	G1	13.72308				
	G2	7.80303	718	18.14	39.6106	.000000
	G3	6.60000				
BMI	G1	22.39042				
	G2	19.74118	135	9.28	14.4983	.000002
	G3	19.40487				
SBJ	G1	168.8269				
	G2	183.3030	9495	452.37	20.9904	.000000
	G3	198.1053				
HGR	G1	21.14423				
	G2	21.84848	60	42.20	1.4297	.242568
	G3	23.46053				
SUP	G1	19.32692				
	G2	21.71212	256	12.49	20.4798	.000000
	G3	24.13158				
BAH	G1	7.58923				
	G2	17.72591	5068	155.87	32.5125	.000000
	G3	29.02737				
SHR	G1	22.30250				
	G2	21.53833	33	4.02	8.3246	.000370
	G3	29.55605				

Legend/Legenda: G - Group (Grupa); M - Means (Aritmetička sredina); F - Fisher's test for statistical significance determination (Fišerov test za utvrđivanje statističke značajnosti); p - Statistical significance (Statistička značajnost); BH - Body height (Telesna visina); BW - Body weight (Telesna težina); TSF - Triceps skin fold thickness (Kožni nabor tricepsa); BMI - Body mass index (Telesni indeks mase); SBJ - Standing broad jump (Skok u dalj iz mesta); HGR - Hand grip dynamometry (Dinamometrija šake); SUP - 30 seconds sit-ups (Podizanje trupa za 30 sekundi); BAH - Bent Arm Hang (Zgib na vratilu); SHR - Shuttle run 10x5 meters (Trčanje 10x5 metara).

In Tables 3-9 the results from the applied Post hoc comparisons in each separate anthropometric and motor variable (in which the significant intergroup differences were previ-

U Tabelama 3-9 prikazani su rezultati primenjenih Post-hok komparacija u svakoj pojedinačnoj antropometrijskoj i motoričkoj varijabli (u kojima su prethodno definisane signifi-

ously defined) between the groups with different level of achievement of the 20 SRT test, are shown.

From these tables we see the statistically significant differences between the group of low level in relation to the groups of medium and high level of cardio respiratory endurance in the anthropometrical variables BMI, WEIGHT and TSF. The results show the negative influence that body mass and the subcutaneous fat tissue exert on the analyzed motor achievement.

Results obtained from the LSD tests show significantly better results in the group of high level of cardio respiratory endurance in relation to the other groups of medium and of low level of achievement in the 20SRT test in all analyzed motor variables. In the same time we have identified significantly low results in all analyzed motor variables of the group of low level of cardio respiratory endurance. The results indicate the important effect of the cardio respiratory endurance level on the achievement of other analyzed motor performances.

Tabela 3: LSD test; varijabla BMI

Table 3: LSD test; variable BMI

	G1 (22.39042) ¹	G2 (19.74118)	G3 (19.40487)
G1		.000006	.000009
G2	.000006		.588530
G3	.000009	.588530	

Tabela 4: LSD test; varijabla BW

Table 4: LSD test; variable BW

	G1 (60.30769)	G2 (53.75000)	G3 (53.78947)
G1		.002830	.009657
G2	.002830		.986751
G3	.009657	.986751	

Tabela 5: LSD test; varijabla TSF

Table 5: LSD test; variable TSF

	G1 (13.72308)	G2 (7.80303)	G3 (6.60000)
G1		.000000	.000000
G2	.000000		.167418
G3	.000000	.167418	

Tabela 6: LSD test; varijabla SBJ

Table 6: LSD test; variable SBJ

	G1 (168.8269)	G2 (183.3030)	G3 (198.1053)
G1		.000334	.000000
G2	.000334		.000809
G3	.000000	.000809	

Tabela 7: LSD test; varijabla SUP

Table 7: LSD test; variable SUP

	G1 (19.32692)	G2 (21.71212)	G3 (24.13158)
G1		.000373	.000000
G2	.000373		.000979
G3	.000000	.000979	

¹In tables 3-9 in brackets are shown the means of each analyzed variable in separate group of subjects, while with bold are shown the important ($p < .05$) intergroup differences.

kantne međugrupne razlike) između grupa ispitanika sa različitim nivoom uspešnosti u testu 20SRT.

Inspekcijom ovih tabela mogu se uočiti statistički značajne razlike između grupe sa niskim nivoom u odnosu na grupe sa srednjim i visokim nivoom kardiorespiratorne izdržljivosti u antropometrijskim varijablama BMI, Weight i TSF. Rezultati ukazuju na negativno determinisanje analizirane motoričke uspešnosti u odnosu na masu tela i podkožnog masnog tkiva.

Dobijeni rezultati LSD testova ukazuju na signifikantno bolje rezultate grupe sa visokim nivoom kardiorespiratorne izdržljivosti u odnosu na grupe sa srednjim i niskim nivoom uspešnosti u testu 20SRT u svim analiziranim motoričkim varijablama. Istovremeno su konstatovani i signifikantno najslabiji rezultati u svim analiziranim motoričkim varijablama grupe sa niskim nivoom kardiorespiratorne izdržljivosti. Dobijeni rezultati ukazuju na visok nivo uslovljenosti nivoa kardiorespiratorne izdržljivosti sa uspešnošću u ostalim analiziranim motoričkim performansama.

Tabela 8: LSD test; variabla BAH**Table 8:** LSD test; variable BAH

	G1 (7.589231)	G2 (17.72591)	G3 (29.02737)
G1		.000022	.000000
G2	.000022		.000017
G3	.000000	.000017	

Tabela 9: LSD test; variabla SHR**Table 9:** LSD test; variable SHR

	G1 (22.3025)	G2 (21.5383)	G3 (20.5560)
G1		.041631	.000072
G2	.041631		.017380
G3	.000072	.017380	

Discussion

Many studies point out the increase of children's and adolescent's fatness and the highly negative influences of obesity and overweight on the health condition of the individual (Eisenmann, et al., 2007; Kovač, et al. 2008; Starc & Strel, 2010; Steele, et al., 2008). The negative influence of the increased body mass, especially of BMI and of subcutaneous fat tissue, on the achievement of various motor tasks is confirmed by many scientific researches (Benedicte, et al., 2003; Kim, et al., 2005; Mota, et al., 2002; Strel, 2006). The results from the conducted National study of 12-19 year old male and female adolescents' health and nutrition in USA show that cardio respiratory capability is greater with those adolescents who have normal body weight in comparison to those who are in the category of overweight (Pate, et al., 2006).

The results of our research are in relation to the above mentioned results, which indicate to significant negative influence of increased body weight and subcutaneous fat tissue on the level of cardio respiratory endurance of 14 year old male students in the Republic of Macedonia.

The results from this research indicate also to the high level of determination (conditionality) of the cardio respiratory endurance from success in other analyzed motor performances, such as hand and shoulder muscle endurance, repetitive body strength, power and speed and coordination (agility).

In context with the results of this research we also have the results from the Moliner-Urdiales, et al. (2009), where it is defined that the lesser muscle strength and the cardio respiratory endurance are connected to the fatness of adolescents while the level of muscle strength of the upper body part, evaluated through the hand grip dynamometry is greater with those adolescents who have greater central body mass. The conducted research is in accordance with the previously conclusions of the same data base (Klinčarov, 2003; Klinčarov & Stojanović, 2005; Klinčarov, Hristovski, & Aceski, 2005; Klinčarov & Stojanović, 2006; Klinčarov, 2008a; Klinčarov, 2008b) which show that in this period of adolescence, among the male students in the Republic of Macedonia, the analyzed basic motor abilities including the cardio respiratory endurance, are positively interdependent, and in the same time are under significant negative influence by the level of body weight, subcutaneous fat tissue and by the level of BMI.

In the end we can state that the interdependences in the motor space of the school population are broadly analyzed,

Diskusija

Veliki broj istraživanja potencira porast gojaznosti kod dece i adolescenata i veliki negativni uticaj gojaznosti i prekomerne telesne težine na zdravstveno stanje pojedinaca (Eisenmann i saradnici, 2007; Kovač i saradnici, 2008; Starc i Strel, 2010; Steele i saradnici, 2008). Negativni uticaj uvećane mase tela, a posebno BMI i potkožnog masnog tkiva, na uspešnost u realizovanju raznih motoričkih zadataka je potvrđen u velikom broju naučnih istraživanja (Benedicte i saradnici, 2003; Kim i saradnici, 2005; Mota i saradnici, 2002; Strel, 2006). Saznanja iz sprovedene Nacionalne studije za istraživanje zdravlja i ishrane kod 12-19 godišnjih adolescenata oba pola u SAD, ukazuju da je kardiorespiratorna sposobnost veća kod onih adolescenata koji imaju normalnu telesnu težinu u odnosu na one u kategoriji sa prekomernom telesnom težinom (Pate i saradnici, 2006).

Rezultati našeg istraživanja su u relaciji sa dosadašnjim saznanjima i ukazuju na značajan negativni uticaj uvećane mase tela i potkožnog masnog tkiva na nivo kardiorespiratorne izdržljivosti kod učenika muškog pola 14-godišnjeg uzrasta u Republici Makedoniji.

Dobijeni rezultati u ovom istraživanju ukazuju i na visok nivo determinisanosti (uslovljenosti) kardiorespiratorne izdržljivosti u odnosu na uspešnost u ostalim analiziranim motoričkim performansama, kao što su mišićna izdržljivost ruku i ramenog pojasa, repetitivna snaga trupa, eksplozivna snaga donjih ekstremiteta i brzina i koordinacija (agilnost). U kontekstu dobijenih rezultata ove studije su i saznanja dobijena od Moliner-Urdiales i saradnici (2009), gde je konstatovano da su manja mišićna snaga i kardiorespiratorna izdržljivost povezani sa debljinom kod adolescenata, dok nivo mišićne snage gornjeg dela tela, procenjena preko dinamometrije šake je veća kod adolescenata sa većom centralnom debljinom tela.

Sprovedeno istraživanje je u saglasnosti i sa prethodnim analizama dobijenih iz iste baze podataka (Klinčarov, 2003; Klinčarov i Stojanović, 2005; Klinčarov, Hristovski i Aceski, 2005; Klinčarov i Stojanović, 2006; Klinčarov, 2008a; Klinčarov, 2008b), koji pokazuju da u ovom periodu adolescencije kod učenika muškog pola u Republici Makedoniji analizirane bazične motoričke sposobnosti, uključujući i kardio-respiratornu izdržljivost, su pozitivno međusobno zavisne, a u isto vreme su pod značajno negativnim uticajem nivoa telesne mase, potkožnog masnog tkiva (procenjene preko kožnog nabora tricepsa) i BMI.

Na kraju može da se konstatuje da su interzavisnosti u motoričkom prostoru kod školske populacije istraživane, no

but yet there is still way for widening the conclusions in this segment, especially for the period of early adolescence. The defined conclusions regarding the relations of the analyzed motor manifestations indicate also to the eventual possibility for choice of smaller number of simple tests for evaluation of students' basic motor performances in this age period.

Conclusion

Having into consideration the fact that in the Republic of Macedonia there are no national tests for evaluating students' motor achievement, including the monitoring and the evaluation of the morphological growth and development of students, in this study we have made an attempt to discover certain interdependences in the cardio respiratory endurance level and the basic anthropometrical measures and the motor performances of 14 year old male students.

The general conclusions from this research are:

- The anthropometric parameters Body mass index, the body weight and the triceps skin fold thickness are a significant negative factor to the level of cardio respiratory endurance of 14 year old male students in the Republic of Macedonia.
- The level of cardio respiratory endurance of 14 year old male students is positive determined by the motor achievement for manifesting arm and shoulder muscle endurance, repetitive body strength, power, speed and coordination (agility).
- Defining of a simple measurable battery of tests for monitoring the physical growth and development of students as a work task for each physical education teacher will provide a future possibility for concluding and comparing these conditions on a national and international level.

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ipak postoji prostor za produbljivanje saznanja u ovom segmentu, posebno za period rane adolescencije.

Definisana saznanja o relacijama analiziranih motoričkih manifestacija ukazuju i na eventualnu mogućnost izbora manjeg broj jednostavnih testova za procenu bazičnih motoričkih performansi učenika u ovom uzrastu.

Zaključak

Imajući u vidu činjenicu da u Republici Makedoniji još uvek ne postoje nacionalni testovi za praćenje motoričke uspešnosti učenika, uključujući i praćenje i ocenjivanje morfološkog rasta i razvoja učenika, u ovoj studiji je napravljen pokušaj da se otkriju određene međuzavisnosti nivoa kardiorespiratorne izdržljivosti i bazičnih antropometrijskih mera i motoričkih manifestacija kod učenika muškog pola 14-godišnjeg uzrasta.

Generalna zapažanja ovog istraživanja su:

- Antropometrijski parametri bodi mas indeks, telesna težina i kožni nabor tricepsa signifikantno negativno determinišu nivo kardiorespiratorne izdržljivosti kod 14-godišnjih učenika muškog pola u Republici Makedoniji.
- Nivo kardiorespiratorne izdržljivosti kod 14-godišnjih učenika muškog pola je pozitivno determinisan motoričkom uspešnošću u manifestaciji mišićne izdržljivosti ruku i ramenog pojasa, repetitivne snage trupa, eksplozivne snage donjih ekstremiteta, brzine i koordinacije (agilnosti).
- Definisane jednostavne, lako merljive, baterije testova za praćenje fizičkog rasta i razvoja učenika kao radna obaveza svakog nastavnika fizičkog vaspitanja će obezbediti u budućnosti mogućnost za sagledavanje i komparaciju ovih sadržaja na nacionalnom i internacionalnom nivou.

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