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THE INFLUENCE OF BODY DIMENSIONS ON SUCCESS IN YOUNGER CATEGORIES IN ALPINE SKIING

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(Original scientific paper)

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Abstract

The goal of the research was to determine the level of relation between body dimensions and competitive success in alpine skiing. There were 28 competitors included in the research, aged 11-12 years, who were competing in the category of younger boys for the Children Grand Prize of Slovenian Ski Association (Mercator Cup in 2012/13). The following 6 body dimension parameters were used in the research: average knee circumference (AKC), average thigh circumference (ATC), body weight (BW), body height (BH), body fat percentage (BF%) and body mass index (BMI). The data was measured with a device for measuring anthropometric dimensions (3D Body Scan). The criterion variables (competitive success) were determined on the base of total amount of points gained in the Mercator Cup (PTS). The analysis showed that the influence of body variables (BV) on the success of younger categories in alpine skiing (PTS) is statistically significant (BV/PTS; R=0.654). The body height (BH; r=0.5) and the body weight parameter (BW; r=0.471) has the greatest influence on the competitive success, while the body fat percentage is the only parameter which doesn't represent so much statistically significant influence. From the collected data big differences in physical development of measured boys are evident, as they are in the pre-puberty development phase and therefore some of them physically develop earlier, while others are physically developed later.

Key Words*: alpine skiing, body characteristics, young categories, successfulness*

Introduction

Alpine skiing is a sport in which the success in competitions depends on various internal and external factors that are related to each other. The findings of the studies are confirming the fact that the success in sports mainly depends on the level of development of basic and special motoric abilities (Bandalo&Lešnik, 2009; Dolenec, 1996; Neumayr et al., 2003; Platzer, Raschner, & Patterson, 2006; Žvan&Lešnik, 2000), but in addition to these also on many other dimensions that can in a given situation each individually influence on the performance (Turnbull, Kilding, & Keogh, 2009; White & Johnson, 1993). In alpine skiing the final result beside psychophysical preparation of competitors depends also on competition conditions such as steepness of the slope, icy conditions on the course, technical complexity of the gates combination (Federolf et al., 2008; Heinrich et al., 2010; Reid et al., 2009; Supej, 2008), equipment and other factors, among which also the body dimensions of the competitors are included (Černohorski&Pustovrh, 2008; Luethi&Denoth, 1987; Norton et al., 1996; Savolainen, 1989; Thompson, Friess, & Knapp II, 2001). Especially the latter are according to observations in practice important particularly with children, as they can be a huge factor by faster sliding down the hill (Müller &Schwameder, 2003; Ducret, Ribot, Vargiolu, Lawrence, & Midol, 2005). In children's competitions for younger boys (11 and 12 years old) it often happens that physically stronger children are in the front. It is a fact that physically stronger competitors have an advantage, especially on more open and technically less difficult competition courses, therefore this fact is to be considered by tracing the courses in the competition events in the future.

The biggest differences in psychomotorical and physical development of children are evident in the developmental stage of adolescence, which in girls occur between the ages 11-16 and slightly later in boys between the ages 12-18 (Faigenbaum, 2000; Thompson, Humbert&Mirwald, 2003). The developmental stage of adolescence begins with the pre-puberty phase, which in boys lasts between the ages 12-14 and in alpine skiing coincides with the competition category of younger boys (SAS, 2012). In

this developmental phase the so called growth spurt is characteristic and consequently leads to a fast increase of someone's dimensions, especially body height and body weight (Marjanovič et al., 2004).

The main goal of the research was to determine the level of relation between individual variables of body measurements and the rate of competitive success among the competitors between the ages 11-12 (the category of younger boys) in alpine skiing. It is a case of measurement sample of participants that are in a delicate developmental stage, in which the start of a rapid physical development is characteristic, with some of the competitors beginning earlier and with others later (Pišot et al., 2003). By setting the goals of the research we also considered the fact that to date not many studies have been carried out, in which on a sample of young competitors it could be confirmed that the success in competitions in younger competitive categories among other factors also depends on body measures.

Material & methods

The sample of participants included 28 competitors in the category of younger boys (aged 11-12 years, born in years 1999 and 2000), who 1.) are without injuries included in the regular training process on the club level or on the level of the national kids team, 2.) in ski season 2012/13 competed in the Mercator Cup and by calculating their rankings gained adequate number of points, 3.) were present at the body dimensions measurements before the start of the ski season (19th October 2012).

The testing of body measures was performed at the Faculty of Sport in Ljubljana on 19th October 2012. Body measurements data were collected with the help of a device [TC]² 3D Body Scan (Fig 1), which represents the most modern technology for acquisition of body measurements information (TC2 - 3D Body Scanning, 2011) and on the basis of expert opinion we applied the following six variables (BV) for further calculations: 1.) average knee circumference (AKC), 2.) average thigh circumference (ATC), 3.) body weight (BW), 4.) body height (BH), 5.) body fat percentage (BF%), and 6.) body mass index (BMI).

Figure 1: 3D Body Scan

The rating of competitive success of the participants was conducted on the base of results achieved in the Mercator Cup between 12th January 2013 and 30th March 2013. Points scoring in the Mercator Cup is conducted in accordance with officially defined rules of Slovenian Ski Association (SAS, 2013http://www.sloski.si/resources/files/pdf/alpsko-smucanje/11-12/Tekmovalni-sistem-2012.pdf). In the younger boys category there were 10 races in both technical disciplines performed, 5 slaloms and 5 giant slaloms. The competitive success rating of participants sample was calculated on the basis of gained points in the Mercator Cup at the end of ski season 2012/13. As a criterion we used the amount of points gained by an

individual when combining his best two results in slalom and best three results in giant slalom (2xSL+3xGS). The more total cup points won, the higher the ranking of the competitor (Table 1).

Table 1: Ranking of competitors based on the calculation of achieved points in the Mercator Cup (Šteharnik, 2013).

Rk	COMP	PTS	Rk	COMP	PTS
1.	A1	705	15.	O1	175
2.	B1	705	16.	P1	152
3.	C1	690	17.	R1	146
4.	D1	601	18.	S1	142
5.	E1	540	19.	T1	140
6.	F1	491	20.	U1	118
7.	G1	462	21.	V1	86
8.	H1	434	22.	W1	85
9.	I1	360	23.	X1	78
10.	J1	309	24.	Y1	39
11.	K1	280	25.	Z1	36
12.	L1	278	26.	A2	34
13.	M1	256	27.	B2	32
14.	N1	186	28.	C2	23
Legend: Rk – ranking of competitors; COMP – competitor; PTS – amount of points gained in the Mercator Cup in season 2012/13					

Data analyzing methods: Measured data were processed with a help of the statistical package SPSS - statistical package for social sciences. In the first step we calculated basic statistical parameters (N, Mean, SD, Min, Max) of all the applied variables, followed by determining a relation between individual variables of body measures and the criterion variables using the method of Pearson's correlation coefficient (r). The main part of the research is associated with the calculation of relation of the whole applied set of body measures variables (BV) with criterion variable (PTS), which was determined by multiple regression analysis and the calculation of multiple coefficient of correlation (R and R Square).

Results

Table 2: Results of basic statistics of body measures variables of older boys in the Mercator Cup 2012/13

	BV						PTS
	AKC	ATC	BW	BH	BF%	BMI	PTS
N	28	28	28	28	28	28	28
Mean	36.907	51.432	52.46	162.29	6.62	19.47	270.82
SD	2.8213	5.2893	11.075	9.929	4.951	2.769	223.446
Min	31	44	35	144	2	16	23
Max	42	64	78	178	20	25	705

Legend: N – number of participants, Mean – average value of measured results, SD – standard deviation, Min – lowest measured result, Max – highest measured result, BV – body variables, AKC - average knee circumference, ATC - average thigh circumference, BW -body weight, BH - body height, BF% - body fat percentage, BMI - body mass index, PTS – cup points (criterion variable).

By analysing table 2 it is evident that body measures data (BV) in this sample of participants varied the most by body weight (BW; SD=11.075) and body height variables (BH;SD=9.929). The measurements show that the difference between the highest (BH; Max=178 cm) and the lowest (BH; Min=144 cm) is 34 cm. There is also a big difference (43 kg) between the heaviest (BW; Max=78 kg) and the lightest participant (BW; Min=35 kg). By body fat percentage variable (BF%) and average thigh circumference variable (ATC) the differences are also big, as the difference between the smallest (ATC; Min=44 cm) and the largest average thigh circumference (ATC; Max=64 cm) is 20 cm. The results of the participants vary the least by body mass index variable (BMI; SD=2.769) and average knee circumference variable (AKC; SD=2.821).

Table 3: Results of calculation of Pearson's correlation coefficient (r) with body measures variables and performance success rating of older boys in Mercator Cup 2012/13

	PTS	BV				
	PTS	AKC	ATC	BW	BH	BF%	BMI
R	1.000	0.349	0.336	0.471	0.500	-0.054	0.300
Sig.	0.000	0.034*	0.040*	0.006**	0.003**	0.393	0.060

Legend: r – Pearson's correlation coefficient of individual body measures variables compared to criterion variables (PTS) , Sig. – statistical significance of correlation between body measures variables and criterion variable (PTS), BV – body variables, AKC - average knee circumference, ATC - average thigh circumference, BW -body weight, BH - body height, BF% - body fat percentage, BMI - body mass index, PTS – cup points (criterion variable)., * - level of risk 5%, ** - level of risk 1%.

The method of calculating Pearson's correlation coefficient (r) and statistical significance (Sig.) showed that the results of the four applied variables (AKC; Sig.=0.034*, ATC; r=0.040*, BW; r=0.006** and BH; r=0.003**) are highly and statistically significant related to competitive success (PTS). Very close to the border of risk level 5% of statistically significance correlation to competitive success is also body mass index variable (BMI; Sig.=0.06). By body fat ratio variable (BF%; Sig.=0.393) the calculations didn't show statistically significant correlations to criterion variable. By analyzing the table it is evident, that the criterion variable(PTS) is influenced the most by body height (BH; r=0.5) and body weight (BW; r=0.47), followed by average knee circumference variable (AKC; r=0.349) and average thigh circumference (ATC; r=0.336) and finally body mass index (BMI; r=0.3), while body fat percentage (BF%; r=-0.05) didn't influence the achieved cup points (PTS).

Table 4: Results of calculation of multiple coefficient of correlation between body measures variables and results of older boys in Mercator Cup 2012/13 (Šteharnik, 2013).

	R	R Square	Sig. F
BV/PTS	0.654	0.428	0.047*

Legend: BV/PTS – body measures variables/criterion variables, R – multiple coefficient of correlation between body measures variables (BV) and criterion variable (PTS), R Square – coefficient of determination R, Sig.F – statistical significance of the multiple correlation, * - level of risk 5%, ** - level of risk 1%.

The results of calculation of multiple coefficient of correlation (R=0.654) confirm the high value of correlation between the whole applied set of body measures variables (BV) and the criterion variable (PTS). The coefficient of determination percentage (R Square=0.428) of the whole set of body measures variables (BV) is almost 43%, while the multiple correlation of included variables sample and competitive success (PTS) is statistically significant at the risk level of 5 %.

Discussion

The present research evolved from the conclusions based on the practical experience. The first goal of the research was to find out if body measures have any influence on success of young athletes in alpine skiing. With obtained results we have confirmed the fact that in the phase of pre-puberty competitive success of our measured sample of participants in the Mercator Cup is, among other factors, also influenced by body measures (Tables 3 and 4). Total number of points gained in the competitions was mainly influenced by body height (BH; r=0.003**) and body weight (BW; r=0.006**), which means that physically taller and heavier competitors achieved better results in the Mercator Cup in the season 2012/13 compared to competitors with lower body weight and height. Maybe the reason, in addition to genetic factors (Silventoinen, Kaprio, Lahelma&Koskenvuo, 2000), for the biggest heterogeneity of results in the mentioned two body measures categories is also the fact that the smaller and lighter competitors haven't yet reached the pre-puberty phase and are therefore in comparison to their peers in underprivileged situation. Body height (BH) and weight (BW) are highly correlated to each other (Bandalo&Lešnik, 2009), as well as statistically significant related to success rate of the observed sample of participants (Table 3). Thus our practical observations are fully confirmed. According to negative effects of rapid growth on movement coordination one could expect that smaller competitors would be more successful and proficient in the competitions (MarjanovičUmek, 2004). Results of both body

measures obtained in our research on the sample of 11 and 12 year-old competitors show that higher values in both body measures categories represent an advantage in the competitions.

Average knee circumference (AKC; Sig.=0.34*) and average thigh circumference (ATC; Sig=0.040*) in comparison to body height (BH) and body weight (BW) have less influence on success of young competitors, but are still statistically significant at the level of 5% risk. Due to the relatively low body fat percentage in our measured sample (BF%; Mean=6.62) we can conclude that in the observed sample of participants prevalent quantity of muscle tissue contributed the most to the measured results of body voluminosity variables (AKC, BW, BF% in BMI). Results from Table 2 confirm that none of the participants excessively deviates from the average (BF%; SD=4,9 in Max = 20). Because in our conclusion the body fat percentage variable (BF%) in comparison to other body measures is the least correlated to success (BF%; Sig.=0.393), we can conclude that at the ages 11-12 muscle and fat tissue ratio doesn't have significant influence on competitive success.

From Table 2 it is evident that among all body measures variables (BV) body mass index (BMI) has the least variability of measured data (BMI; SD=2.76). This means that the homogeneity of results is the highest, although the influence of this variable on competitive success in comparison to body weight influence (BW) is lower, but still at the border of statistical significance (BMI; r=0.3, Sig.=0.06). In younger categories of competitors in alpine skiing are therefore competitors with bigger voluminosity more successful, regardless of their body weight and height ratio. It has to be pointed out that this applies only for the children with not yet perfected technical skiing skills, as it opens more options for compensating their technical weaknesses with body weight.

The analysis of values of the results of multiple coefficient of correlation (R) also shows that the chosen body measures variables model (BV) covers almost 43% of variance (R Square) and statistically significant influence on competitive success (BV/PTS; Sig. F=0.047*). The given fact means that the correlation of the whole set of body measures variables is statistically significant related to success in competitions, along 58 % of other factors which also have influence on competitive success of our sample of participants (Table 4). Among these other factors we can identify movement abilities, genetics, psychological strength, weather conditions, coaching, conditions in the club, technical and tactical preparation of the competitor, financial resources and many other factors that were however not included in our research.

Conclusion

Among many different factors for success in alpine skiing two factors stand out – movement abilities and body characteristics of competitors. There is a crucial difference between these two factors, as we can largely influence on movement skills and systematically build the base for successful development already in early childhood, while body measures are in most cases genetically determined and we cannot have much influence on many of them. Constitution of competitors in alpine skiing is therefore significantly related to achieving good results in alpine skiing (White & Johnson, 1993). That the latter fact has a big effect in younger categories was also shown in this research. Our findings represent an important contribution for the choice of content of the training process as well as the choice of sports nutrition and other factors that in one way or another significantly influence on achieving good results. The results of the research are confirming practical observations; therefore, it is important that the course-setters in kids' competitions take these facts into consideration. In the future technically more demanding courses will be needed in competitions to prevent the advantage of bigger body weight. Tactical skills and method of taking on the gates – the choice of optimal line in accordance with individual's ski knowledge and abilities on the technically more challenging courses – must necessarily become the most important part of preparation for competitive period of the training process in younger categories of skiers.

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PSYCHOLOGICAL AND SOCIAL FACTORS OF ESTIMATES OF EFFECTS OF RECREATION

UDC: 796.035:316.644
(Original scientific paper)

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Abstract

For a proper understanding of the contents of recreation in the everyday lives of people in general, as well as in certain social groups within which the certain recreational activities are carried out, it is necessary to consider the most important factors that influence and determine directly or indirectly man in relation to recreation. Since it is likely that a number of factors determines commitment of individual to engage in recreational activities, it is expected that the very evaluation recreation effects will be different, both in scope and intensity, because people differ in a number of social - experiental and personal characteristics. Given that in our society tremendous changes occurred, it is very interesting to correlate psychological and sociological factors as drivers of certain recreational facilities and activities. Performing of these activities the specific needs of individuals are satisfied as well as society at all. This research was conducted with the aim to review the assessments of the effects of recreation in the interconnectedness of psychological and social factors. The research was conducted on a sample of 553 participants, residents of the western part of the Republic of Srpska, of which 132 participants did not engage in recreation, 169 of them are engaged in recreation occasionally, and 252 subjects engaged in recreational activities regularly. This study used questionnaire for assessing the effects of recreation and scale for testing the general attitude towards recreation. The survey showed that participants estimate that for them the greatest effect recreation "in health", and the smallest effect "in fashion and contemporary trends", that is half the participants significant source of differences in the assessment of the effects of recreation, and that, regardless of place of residence, is dominated by an assessment of the significance of recreation for health. Global overview of the results shows that among the participants prevailed moderately positive and vacillating attitude toward recreation.

Key words: *psychological and social factors, sports, recreation, sex, place of residence, the effects.*

Introduction

For a proper understanding of the contents of recreation in the everyday lives of people in general, as well as certain social groups within which the certain recreational activities are carried out, it is necessary to consider the most important factors that influence and determine directly or indirectly man in relation to recreation. 18% of 24 billion dollars are the costs for heart disease, which are attributed to absence of physical activity, as well as 22% of the $ 2 billion for patients with colon cancer (Colditz, 1999). In the UK 20% of the population is obesity, the cost which are partly attributed to the absence of physical activity are estimated at 500 million pounds a year, and obesity and related diseases at the same population cause 18 million days of sick leave (Close, 2006; Hill et al., 2007). It is certain, however, that active involvement in human recreation and its relationship to these activities shows his complete personality, which determines the different features and social environment in which man lives. The economic consequence caused by physical inactivity is estimated at 910 million euros for a population of 10 million people, with half of physically inactive. Recorded 3.1 million days of accrued sick leave as may be related to physical inactivity in a population of 5.5 million people (Petrovic-Oggiano et al., 2010). Studies of incidence of infection, which can occur as a consequence of modern life dominated by sedentary style, aimed at determining the correlation level of physical activity with the degree of illness in certain groups of diseases (HNB/MNB), have shown a reduction in mortality rates when performed

regular physical activity (Paffenberger, 1994), and that walking and jogging replaced treatment and rehabilitation (Tanasescu et al., 2002). Lack of physical activity (12% - 14%) causally associated with colorectal cancer (Slattery, 2004), 7, and provides the highest level of protection of breast cancer (Fridenreich et al., 2001). Since it is likely that a number of factors determines orientation of individual to engage in recreational activities, it is expected that the very evaluation recreation effects will be different, both in scope and intensity, because people differ in a number of social-experiental and personal characteristics. In addition, it is likely that, despite the general relationship (positive or negative) of the citizens towards recreation, will be made out important differences in relation to certain effects that citizens prefer, from whom they expect a greater benefit. As a part of the elaboration of the problems of pedagogical-psychological characteristics as factors to assess the effect of recreation, it is necessary to consider not only each other connection of characteristics collected from participants assessments as recreation, but also to determine whether and to what extent the pedagogical-psychological characteristics of factors assess the effect of recreation. In other words, whether and in what manner the direction and intensity with which the pedagogical-psychological characteristics of participants determine the assessment of the effects of recreation. Given that in our society, tremendous changes occurred, it is interesting to correlate psychological and sociological factors as drivers of certain recreational facilities and activities, of which the practice is meeting the specific needs of individuals and society. The importance of small sporting events of regional, local or amateurs do not have a lot of public attention because of minor economic importance to the state, but have a positive economic impact on the host contests and encourages the development of the tourism industry of the region (Daniels, 2003). If we talk about determinants that influence the acceptance and involvement (or non-acceptance, passivity), it seems that is necessary to ask the question: What are the dynamic forces that encourage or discourage participation in sports and recreational facilities and activities, and what personality characteristics are determined the behavior of individuals? This research was conducted with the aim to review the assessments of the effects of recreation in the interconnectedness of psychological and social factors.

Materials and Methods

Given the complexity of the case studies, formulated aim of research and selected research methods, the research was conducted on a sample of 553 participants, residents of the western part of the Republic of Srpska (Prijedor, Gradiška, Srbac and Banja Luka), of which 132 participants did not engaged recreational activities, 169 of them are engaged in recreation from time to time, and 252 subjects engaged in recreation properly. The sample size and the method of selecting participants who are not actively involved in recreation is done on the model of a multi-stage stratified random selection, while other participants were chosen from groups: Physical Education Teachers, active amateurs (club members) or the ones who are currently involved in the implementation of programs of some recreational groups.

Bearing in mind the choice of possible sciental methods, and taking into account the nature of the problems that research, the types of data collection instruments and other factors, in a study we use two methods: the method of theoretical analyze and empirical - nonexperimental method or Survey method. Applying the above methods is done empirical research and testing the asess of the effect of dealing with recreation, but also established social status of the participants. Survey method as a form of field research is used to collect and analyze data in order to determine the state, establishing a tendency and drawing conclusions of general views and their universal meanings. In this study for the purposes of collecting relevant data will be used the following instruments: a questionnaire for assessing the effects of recreation (the questionnaire was anonymous, and was filled with the written instructions which were given by the interviewer, and with help of instructions that are listed with each question, where it was necessary) and the Scale for the questioning of the general attitude towards recreation (Likert summation scale intended for questioning relations of subjects to different aspects of recreation, the reliability of the scale was determined using the "split-half" procedure, which checks consistency - the correlation between half of the scale is 0.6984, and the coefficient of reliability was calculated using the Spearman-Bronjn formula is 0.8152). For the processing of the data used statistical program SPSS 17.00. In other words, in data processing, in addition to frequency and percentages were calculated measures of central tendency (arithmetic mean) and variability (standard deviation), the association between variables (Score correlation) and testing of statistical significant of difference between the relevant variables (Hi-square test).

Results and discusion

Table 1. Assessment of the impact of recreation

Effects of recreation	f	%
1) in health	177	32.00
2) for rest and relaxation	103	18.62
3) prolonging the life and working life	67	12.11
4) for fun and pleasure	61	11.03
5) maintaining the working capacity of	47	8.49
6) maintaining a beautiful looking	42	7.59
7) for a pleasant Leisure time	29	5.24
8) the regulation of body weight	12	2.16
9) for self-assertion	3	0.54
10) in fashion and modern trends	0	-
11) I do not see the benefits of recreation	5	0.90
0) no response	7	1.26

Insight into the results presented in Table 1. shows that participants estimate that for them personally, the greatest effect of recreation "in health care," as stated 32.00 percent of the participants, and the smallest effect "in fashion and contemporary trends", because neither one participant pleaded in following new trends see the benefits of recreation. Another major effect of dealing with recreation is that recreation serves "for rest and relaxation" as 18.62 percent of participants pleaded, followed by: to extend the life and work (12.11%), for fun and pleasure (11, 03%), maintenance of working ability (8.49) and maintain a beautiful appearance (7.59%). In this study of socio-psychological characteristics of participants were analyzed sex and place of habitation. The results obtained are presented in Table 2. and Table 3.

Table 2. Gender of participants and estimation of the effects of recreation

Sex	Assessment of the effects of recreation										
	Preservation health	*Maintenance capabilities*	*Maintenance vitality*	*Regulation of body weight*	*Beautiful appearance*	*The rest and relaxation*	*Fun*	*Socializing*	*Self-assertion and affirmation*	*There is no benefit of recreation*	Σ
male	116 34. 94	29 8.73	37 11.14	4 1.20	29 8.73	56 16.87	46 13.86	9 2.71	3 .90	3 .90	332
female	61 28.50	18 8.41	30 14.02	8 3.74	13 6.07	47 21.96	15 7.01	20 9.35	0 0.00	2 .93	214
Σ	177 32.42	47 8.61	67 12.27	12 2.20	42 7.69	103 18.86	61 11.17	29 5.31	3 .55	5 .92	546

Pearson Chi-square: 27.5213, df=9, p=.001150

Insight into the results shows that half of the participants significant source of differences in the assessment of the effects of recreation, considering that the obtained chi-square = 27.5213, with 9 degrees of freedom, statistically significant at the 0.01 level. This means that the differences in the assessment of the effects of recreation statistically significant with regard to patient sex, as can be seen in Table 2.

Table 3. Place of residence of participants and estimation of the effects of recreation

Place of residence	Evaluation of the effects of recreation										
	Preservation health	*Maintenance capabilities*	*Maintenance vitality*	*Regulation of body weight*	*Beautiful appearance*	*The rest and relaxation*	*Fun*	*Socializing*	*Self-assertion and affirmation*	*There is no benefit of recreation*	*Σ*
city	87 31.99	37 13.60	26 9.56	7 2.57	8 2.94	62 22.79	34 12.50	7 2.57	3 1.10	1 .37	272
suburb	57 34.55	1 .61	31 18.79	0 0.00	22 13.33	10 6.06	19 11.52	21 12.73	0 0.00	4 2.42	165
village	33 34.02	9 9.28	10 10.31	5 5.15	12 12.37	23 23.71	4 4.12	1 1.03	0 0.00	0 0.00	97
Σ	177 33.15	47 8.80	67 12.55	12 2.25	42 7.87	95 17.79	57 10.67	29 5.43	3 .56	5 .94	534

Pearson Chi-square: 107.783, df=18, p=.000000

Insight of the results of interconnection assessments of the effects of recreation with the participant's place of residence shows that in all participants (Table 3), regardless of place of residence, dominate an assessment of the significance of the recreation for health care, but that differences occur in the other aspects.

Table 4. The general attitude toward recreation and assessment of recreation effects

The general attitude towards recreation	Assessment of the impact of recreation										
	Preservation health	*Maintenance capabilities*	*Maintenance vitality*	*Regulation of body weight*	*Beautiful appearance*	*The rest and relaxation*	*Fun*	*Socializing*	*Self-assertion and affirmation*	*There is no benefit of recreation*	*Σ*
Mostly negative	0 0.00	0 0.00	3 100.0	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	3
Unsure	29 28.16	13 12.62	7 6.80	4 3.88	1 .97	29 28.16	1 .97	11 10.68	3 2.91	5 4.85	103
Mostly positive	133 34.64	26 6.77	43 11.20	8 2.08	24 6.25	74 19.27	58 15.10	18 4.69	0 0.00	0 0.00	384
Extremely positive	15 26.79	8 14.29	14 25.00	0 0.00	17 30.36	0 0.00	2 3.57	0 0.00	0 0.00	0 0.00	56
Σ	177 32.42	47 8.61	67 12.27	12 2.20	42 7.69	103 18.86	61 11.17	29 5.31	3 .55	5 .92	546

Pearson Chi-square: 162.349, df=27, p=.000000

The research results obtained (Table 4) show that there are significant distinctions in assessing the effects of recreation with respect to the direction and intensity of general attitude towards recreation. The resulting chi-square = 162.349, with 27 degrees of freedom is statistically significant at the 0.01 level, which means that the established differences are statistically significant, as it can be seen in Table 4. Global overview of the results shows that the subjects prevailing moderately positive and unsure attitude toward recreation, while a negative attitude completely negligible, because none of the participants has no meanengly negative relationship, and only three or 0.55 percent of participants have a moderate negative relationship, as it can be seen from Table 4.

Discussion

In this study, we assume that the social environment can significantly affect the individual, and that these effects show through the action of the factors in the immediate and wider social situation. Hence, in considering the interconnection effects of recreation and participants' characteristics of social experience takes into account and the impact of characteristic of social groups which the participant belongs. Research conducted in the countries of the European Union on a sample of 24,791 participants from 2004 shows that the reasons not to engage in physical activity for 34% of participants lack of time, 25% do not like sports, 4% is too expensive, and 3% have no adequate sports infrastructure close of life, and that the reasons for dealing with some physical activity improve health (mental and physical) 78%, the development of physical abilities 46%, 43% relaxation, entertainment 39%, to be with friends 31%. Stojiljkovic (1995) states that motives for engaging in recreation group membership 23%, relaxation and improve mental and physical fitness and health 14.6%, caring for ill health 9.5%, 6.8% aesthetic orientation and prestige and fashion 6.3% . It is obvious that health, home, beautiful appearance and maintenance work and life skills are the most important effects of the recreation of which participants expect the greatest benefit, so that it becomes desirable activity with positive effects. It is interesting to note that a very small number of participants estimated that "there is no benefit of recreation," as declared only 0.90 percent of participants. Global score distributions to assess the effect of recreation on a sample of these participants clearly shows a high degree of positive evaluation on the effects of recreation. Research (Dragosavljević et al., 2014) conducted in the Bosnian entity - Republic of Srpska found that participants do not participate in sports and recreational activities (32.2%) or rarely practice them (23.2%), while 13.8 % do so every day, and that men are far more active in sports recreation activities than women. The analysis of the results shows that the first two places in the ranking, both men and women prefer same aspects of recreation, except that slightly more males (34.94%) than women (28,50) estimates that for them the greatest benefit from recreation in health, and slightly more women (21.96%) compared to males (16.87%) in rest and relaxation. In other respects they differ assessment of subjects, because the third party men estimate (13.86%) compared to women (7.01%), while women maintain viability (14.02%) compared to men (11.14%). Another important result of this study is that the trainees at the self-assessment of health and attractiveness were significantly more positive than those who were not engaged (A. Djordjevic, 2002). It was assumed that the place of residence, also play an important role in the formation of attitudes towards recreation. For example, those who live in the countryside estimate that in addition to preserving health (34.02%) is the biggest benefit of rest and relaxation (23.71%) and the beautiful appearance (12.37%), and residents of suburban areas to the next preservation health (34.55%) is the biggest benefit of recreation in maintaining vitality (18.79%), aesthetic (13.33%) and socializing (12.73%), while participants who live in the city estimated that in addition to preserving health (31.99%) the biggest benefit is the rest and relaxation (22.79%), maintenance capability (13.60%) and entertainment (12.50%). Havelka and Lazarevic's results of exploration (Havelka and N. Lazarevic, Lj., 1981) and Galic (Gali M., 1995) showed that socio-demographic factors are quite influential in sports participation. In a number of factors that could significantly affect the assessment of the effects of recreation are certainly factors of valuator, or psychological factors. We believe in fact that the assessment of the effects of recreation closely associated not only with a range of experience characteristics of participants but also with his psychological characteristics. Among the main characteristics of personality, in addition to uniqueness, unity, coherence, identity and maturity, belongs and self-consciousness (Pajević, 2003). Research Bouillet (2008), which reflects in Perasović's (2009) work, confirms the fact that shows that young intellectual potential social elite (sample of 325 students in Zagreb) their ideal leisure see in almost total passive form. The starting point, namely, that the attitudes formed in social interaction to represent readiness of individual to react in a certain way in social situation, to reflect the active relationship between individual and appearance in more social situations, and that are associated with the behavior, it means that directly or indirectly influence the actions of individuals to the phenomenon. In other words, we believe that the general attitude towards recreation can significantly affect the assessment of the effects of recreation. Analysis of the results obtained on the interrelation between the general attitude towards recreation and recreation effects assessment shows that within the general positive attitude of the majority of participants to the recreation there are significant differences with regard to the assessment of the effects of recreation. These differences are the most significant in subjects who are unsure of the general attitude towards recreation. Among the participants who are unsure attitude toward recreation is evident that the tendency of dealing with recreation can

benefit in all aspects, but it is in this category of patients is evident and the most pronounced understanding that they do not see any benefits from recreation. On the other hand, in patients who have a positive attitude towards recreation there are evident differences in the assessment of the personal benefit of the individual aspects of dealing with recreation. For example, participants who have generally positive attitude towards recreation estimate that for them personally, the biggest benefit of recreation is a prevention of health (34.64%), rest and recreation (19.27%) and entertainment (15.10%) while the patients who have an extremely positive attitude towards recreation have the most common estimates that the benefits of recreation is conformity of looks and movement, beautiful looking (30.36%), then preservation health (26.79%), and maintenance of vitality (25.00%). Such a situation can be found in the aftermath of the war, but the lack of respect of the community towards this area that is not so attractive as a marketing professional sport. (Dragosavljević, 2008). Also, the lack of organization and organized exercise, and lack of green spaces and sports facilities, could be one of the reasons for these results.

Conclusion

Looking at the whole sample, it can be seen that participants share the opinion that engaging in recreational activities should have effects in health, for rest and relaxation, prolonging life and work, and for fun and pleasure. While, looking at interest for recreational activities by gender showed that women engage in recreational activities for prevention the health, rest and relaxation, and maintaining vitality, and men for the preservation health, rest and relaxation, fun, maintaining vitality, maintenance ability and good looks. It turned out that the place of residence conditioned the reasons for engagement in recreational activities, thus participants who live in the city and suburbs consider that the effects of recreation are maintaining of health and vitality, while those who live in the village consider that the effects of recreation should be to maintain health, rest and relaxation. Global overview of the results shows that the subjects prevails moderately positive and vacillating attitude toward recreation, while a negative attitude completely negligible, because none of the participants has no meaningly negative relationship, and only three or 0.55 percent of participants have a moderate negative relationship. This research has shown that awareness of the participants about the exercise and recreational activities developed to a great extent, and that the analysis of psychological and social factors received enough reliable information on the participants' needs for recreational activities, and their wants and needs in relation to sex and place housing. It can be concluded that this study demonstrated that the organization of recreational activities should be approached by analyzing many aspects and factors that may contribute to the pursuit of recreational activities, take into account the views and needs of the area in which they want to develop a culture for recreational activities and involve experts of various profiles in order to achieve the objectives and enable the conditions for engaging in organized recreational activities.

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DIFFERENCES BETWEEN PHYSICAL FITNESS PROFILES OF MACEDONIAN ADOLESCENT IN URBAN AND RURAL AREAS IN STRUMICA, REPUBLIC OF MACEDONIA

UDC:796.015.132:572.087.1-053.6(497.7)
(Original scientific paper)

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Abstract

Anthropological characteristics of the children have often been subject of researching in the kinesiology, but still there is a small number of researches that studied the influence of the residential status among the physical fitness and anthropometrical characteristics, especially in our state. The theoretical and empirical research was conducted on a sample of 2199 participants, drawn from 9 primary schools from the Municipality of Strumica, Republic of Macedonia, from which 5 are situated in rural and 4 in urban environment. The differences in the variables between the participants with various residential statuses are analyzed with multivariate and univariate analysis of variant (MANOVA and ANOVA). The results point out that boys from middle school age who are studying in rural areas have lower average values of the systolic pressure, lower height, lower weight, lower body fat, body mass index and they show better results in endurance in pull-ups, pin running 4x10 meters and three minute step test. Boys from the middle school age who are studying in rural areas show better results in the tests: flamingo, tapping with hand and raising the trunk in 30 seconds. Girls from the middle school age who are studying in rural areas have higher average values of the systolic pressure, lower height, lower body fat and show better results in fitness tests: flamingo, tapping with hand and raising the trunk in 30 seconds. On the basis of the achieved results it could be assumed that the environmental factors in different environments contribute to differences in the anthropological characteristics of the participants.

Key words: *Adolescent, Rural, Urban, Anthropometry, Physical fitness, Measurements*

Introduction

The concept of physical fitness is as old as humankind. Throughout the history of mankind, physical fitness has been considered an essential element of every day life. The ancient people were mainly dependent upon their individual strength, vigor and vitality for physical survival. This involved mastery of some basic skill like strength, speed, endurance, agility for running, jumping, climbing and other skills employed in hunting for their livings.

The physical fitness is connected to the health condition during the childhood and adolescence (Myers J, et.al. 2002; Andersen LB, et.al 2006). Even among children, fitness is inversely associated with cardiovascular risk factors for chronic disease such as high blood pressure (Sallis JF, et al. 1998; Ruiz JR, et. al. 2006), total fatness (Ruiz JR, et al. 2006), hyperinsulinemia (Gutin B, et al. 2004), abdominal adiposity (Brunet M, et.al. 2006), atherogenic lipid profile (Mesa, J.L, et al. 2006) insulin resistance (Gulati M, et. al. 2003), and clustering of metabolic risk factors (Brage S., et al. 2004; Ruiz J.R, et. 2007). Unfortunately, in the last two decades we have witnessed more evident tendency of decreasing the physical activity among children, that happens not only in our state, but in the nearby countries too (Šiljeg, Zečić, MrganandKević, 2008; Strel, Bizjak, Starc and Kovač, 2009), as well as in the developed countries (Janz, Dawson& Mahoney, 2000; Tomkinson, Olds &Gulbin, 2003; Wedderkopp, Froberg, Hansen & Andersen, 2004).

Huge number of the environmental factors such as: socio-economic status, cultural influence, life style, health condition and many other factors have influence upon the level of physical activity among children and at the same time there is also an indirect influence upon the anthropological characteristics of the children. Both, children and youngsters differ at the level of physical fitness regarding the socio-

economic characteristics, as well as the living environment and that is because they depend on the economic and cultural potentials of their family.

Parents and environment have great influence on development of the abilities and characteristics of most adolescents, whereby they have big responsibility for their proper psycho-physical development, education and development of the total abilities, whose influence is especially important for the sport results achieved by the children.

The first assumption of this research is that the students from different residential status have different level of physical fitness. In our state, there are no researches for the physical fitness among the students, regarding different residential status, whereas many foreign authors dealt with this matter during the last few years (Loucaides, Chedzoy, & Bennett, 2004; Eiben, Barabás, &Németh, 2005; Badrić & Petračić, 2007; Bathrellou et al., 2007; Petrić, 2009; Tinazci&Emiroğlu, 2010).

Methods

The research is conducted on a sample of 2199 participants, which is 97% from the total population of students of the researched age, at the primary schools in the Municipality of Strumica, Republic of Macedonia. There are 9 primary schools in the Municipality which are in rural environment and 4 are in urban environment. The sample is divided into two subsamples according to the gender as follows: 1124 participants are male (684 from urban and 371 from rural) and 1075 participants are female (665 from urban and 363 from rural). The average age of the participants from both genders is12,31years.

All the students who participated in the sample obtained consent from their parents that they allow them to participate in the project and were psycho-physically healthy and regularly attended classes of physical and health education. The participants were treated pursuant to the Helsinki Declaration.

The measuring was realized in March, April and May, 2012, in standard school conditions during the regular classes of physical and health education. The measuring was conducted by professionals from the area of kinesiology and medicine, who were previously trained for measuring of the determined tests and measurements.

Anthropometric measurements

Anthropometric measurements were taken according to standard methodology of International Biological Program (IBP) and according to the recommendations of the World Health Organization (WHO) and Weiner-Lurie (Weiner JS, Lourie JA., 1981).

Weight was measured in underwear and without shoes with a medical decimal weight scales, to the nearest 0.1 kg, and height was measured barefoot in the Frankfort horizontal plane with a telescopic height measuring instrument (Martin's anthropmeter) to the nearest 0.1 cm. Body mass index was calculated as body weight in kilograms divided by the square of height in meters.

The components of the body composition are determined by the method of bioelectrical impedance (measuring of electrical conductivity - Bioelectrical Impedance Analysis - BIA). The measuring was realized by the Body Composition Monitor, model "OMRON - BF511", by which the body weight, the percentage of body fat, percentage of muscular mass and the index of body mass were measured (BMI).

Before the measuring in the Body Composition Monitor the following parameters were being entered: gender, age and height of the participant.

In order to achieve maximally precise results during the measuring i.e. evaluation of the body composition, preconditions which are recommended by ACSM (2005) and Heyward (2006) were fulfilled before every measuring.

Evaluation of Physical Fitness

Prior to starting the study, the researchers involved in the project undertook training sessions in order to guarantee the standardization, validation, and reliability of the measurements (Moreno LA, et. al. 2003). Seven tests, forming part of the EUROFIT battery, validated and standardized by the European Council, were applied in the following order:

1. Sit and Reach test. With the subject seated on the floor and using a standardized support, the maximum distance reached with the tip of the fingers by forward flexion of the trunk is measured. Test indicative of amplitude of movement or flexibility.
2. Flamingo. Balancing on one leg as long as possible while standing on the preferred foot. This test measures general balance.

3. Plate Tapping Test. Rapid tapping of 2 plates alternately with the preferred hand. The subject performed 25 cycles for 2 times, and the better result was the score.
4. Hand Grip test. By use of a digital Takei TKK 5101 dynamometer (range, 1-100 kg), the maximum grip strength was measured for both hands.
5. Standing broad jump test. The maximum horizontal distance attained, with feet together, was measured. This test evaluates lower limb explosive-strength.
6. Bent Arm Hang test. A standardized test was used to measure the maximum time hanging from a fixed bar. This test estimates the upper limb endurance- strength.
7. Sit-ups 30 sec. Maximum number of sit ups achieved in 30 seconds. This test measures the endurance of the abdominal muscles
8. Shuttle run: 4×10 meters. This test provides an integral evaluation of the speed of movement, agility and coordination. The subject does four shuttle runs as fast as possible between 2 lines 10 meters apart. At each end the subject places or picks up an object (a sponge) beside the line on the floor.
9. The three-minute step test. The aerobic capacity has been estimated by means of a 3-minute step test. The respondent had a task, for 3 minutes, to get up and get down of a bench 30,5 cm high, in four cycles (up, up, down, down), with standardized rhythm of 96 beats in a minute (bmp), which was dictated by the metronome. Before beginning of the test we have measured the heart frequency, whereas the adolescent, even in the stand-by state had sub maximal value in terms of the age, were not exposed to burdening. The heart rate was measured by means of the monitor Polar RS800 for registration of the heart frequency. The average of the heart rates measured immediately after taking the test and a minute after that make up the test result.

Blood Pressure

Measuring of blood pressure (systolic and diastolic) and heart rate were realized by professionals in the area of medicine, doctor- specialist in sports medicine. The measurements were performed in special premises with optimal ambiental conditions in relaxed condition of the participant, where the relaxation was performed at least one minute before the measuring. The measuring was realized on the forearm above the wrist of the palm, with a clinically tested electronic digit device for measuring of the blood pressure by the firm „Omron". The measuring was performed on the left hand and before it was taken into consideration for the cuff to be properly set, the hand to be on the same height as the heart and the participant to sit upright, not to move or talk. The blood pressure was measured for three times in the interval of 60 seconds and the average value of the three measuring was taken as result thereof.

Statistical analysis

The data represented mean (SD) for continuous variables. The differences in the variables between the participants from different residential status are analyzed with the multivariable and univariable analysis of variant (MANOVA and ANOVA). The normality of the distribution of changed variables is tested with Kolmogorov-Smirnov's method. All the analyses were performed using the Statistical Package for Social Sciences software (SPSS,v.16.0 for WINDOWS; SPSSInc., Chicago, IL, USA) and values of $p<0.05$were considered statistically significant.

Results

The testing of the normality of the distribution with Kolmogorov-Smirnov's procedure showed that most of the variables among the participants from both genders do not deviate from the normal distribution.

Tables 1 and 2 show the average values, standard deviations and the values of the multivariate and univariate analysis of the covariate of the parameters for evaluation of the blood pressure, anthropometrical measurements, body composition and tests for evaluation of the level of physical fitness after the partition of the ages among the participants from both genders.

From the analysis of Table 1. we can see that are determined statistically significant differences on multivariate level in the system variables for assessing blood pressure, anthropometric measures, body composition and physical fitness levels among boys who are studying in urban and rural environment. The value of the F test for the whole system analyzed variables is statistically significant at the level of

assessment Q < 0.00.

From the analysis of the Table 1 results we can see that univariate level exist on statistically significant differences in the variables diastolic pressure (p < 0.01), body height (p<0.04), body weight (p<0.00), percentage of body fat (p<0.01), body mass index (p<0.04), as well as the tests for assessing the level of fitness: flamingo (p<0.01), plate tapping (p<0.01), raising the trunk in 30 seconds (p<0.00), endurance in pull-ups (p<0.05), pin running 4x10 meters (p<0.00) and three minutes step test (p<0.00).

Boys from the middle school age who are studying in rural areas have lower body fat, body mass index and show better results in the tests: endurance in pull-ups, pin running 4x10 meters and three minute step test. Boys from the middle school age who are studying in urban areas show better average results in the tests: flamingo, palm tapping and raising the trunk in 30 seconds. Statistically significant differences between the boys who are studying in urban and rural areas are not defined in systolic pressure, percentage of muscle mass and fitness tests: standing broad jump test, hand dynamometry and sitting hamstring stretch.

Table 1.Differences between urban and rural male adolescent

Wilks'Lambda	Rao's R	df 1	df 2	Q
0,84	12,00	16,00	1037,00	**,00**

Variable	Urban		Rural		F	p
	Mean	SD	Mean	SD		
Systolic pressure (mmHg)	113,91	8,74	114,64	8,10	1,91	,17
Diastolic pressure (mmHg)	71,53	8,05	70,38	7,82	5,14	**,02**
Height (cm)	157,51	10,86	156,40	10,10	4,33	**,04**
Weight (kg)	52,39	14,31	50,00	13,71	8,19	**,00**
Body fat (%)	20,64	8,54	19,30	8,17	6,35	**,01**
Muscular mass (%)	36,49	3,36	36,76	3,42	2,00	,16
BMI (kg/m^2)	20,78	4,04	20,25	4,07	4,07	**,04**
Flamingo (s)	3,19	2,13	2,59	1,61	22,95	**,00**
Standing long jump (cm)	161,75	27,99	162,16	29,08	,06	,81
Plate Tapping	13,81	2,46	14,48	2,55	20,10	**,00**
Sit-ups 30 sec. (n)	19,29	4,25	18,34	4,35	12,18	**,00**
Bent arm hang (s)	10,24	11,06	11,63	11,13	3,93	**,05**
Handgrip (kg)	43,00	18,43	44,81	17,67	3,52	,06
Sit and reach (cm)	15,39	6,65	16,02	6,99	2,09	,15
Shuttle run 4x10 m	12,31	1,19	11,85	0,97	44,16	**,00**
Three-minute step test (bmp)	113,79	20,01	108,29	19,22	18,55	**,00**

From the review of Table 2 we can see that among girls who are studying in urban and rural areas there are statistically significant multivariant differences defined for the whole system of analyzed variable (Q<0.00). On the univariant level statistically significant differences between girls who are studying in urban and rural areas are determined in functional measures of the systolic pressure (p<0.01), body height (p<0.04), percentage body fat (p<0.01) and the fitness tests> flamingo (p<0.00), standing broad jump (p<0.01), palm tapping (p<0.01), raising the trunk in 30 seconds (p<0.00), endurance in pull-ups (p<0.01), hand dynamometry (p<0.00), pin running 4x0 meters (p<0.00) and three minute step test (p<0.04). Girls from the middle school age who are studying in rural areas have higher average values of the systolic pressure, lower height, lower weight, lower percentage of body mass and show better results in fitness tests: standing board jump, endurance in pull-ups, hand dynamometry, pin running 4x10 meters and three minute step test.

Girls who are studying in urban environment show better results in fitness tests: flamingo, palm tapping and raising the trunk in 30 seconds. Statistically significant differences between girls who are

studying in urban and rural environment are not determined in the diastolic blood pressure, body weight, percentage of body fat, body mass index and fitness test: sitting hamstring stretch.

Table 2.Differences between urban and rural female adolescent

Wilks'Lambda	Rao's R	df 1	df 2	Q
0,81	14,42	16,00	1010,00	**,00**

Varijable	Urban		Rural		F	p
	Mean	SD	Mean	SD		
Systolic pressure (mmHg)	113,78	8,35	115,11	7,48	6,59	**,01**
Diastolic pressure (mmHg)	72,30	7,63	72,43	7,62	,07	,79
Height (cm)	156,85	7,49	155,95	7,70	4,24	**,04**
Weight (kg)	51,91	11,96	50,53	11,83	3,49	,06
Body fat (%)	25,68	7,69	24,39	7,91	6,74	**,01**
Muscular mass (%)	32,95	2,36	33,07	2,70	,56	,46
BMI (kg/m^2)	20,96	4,01	20,90	4,38	,05	,82
Flamingo (s)	2,55	1,40	2,28	1,15	9,77	**,00**
Standing long jump (cm)	130,84	20,57	134,24	22,55	6,03	**,01**
Plate Tapping	15,06	2,87	15,53	2,90	6,88	**,01**
Sit-ups 30 sec. (n)	15,70	3,86	14,92	4,15	9,14	**,00**
Bent arm hang (s)	3,47	4,82	4,31	4,90	7,11	**,01**
Handgrip (kg)	33,19	11,97	35,34	12,26	9,04	**,00**
Sit and reach (cm)	19,71	6,72	20,24	6,78	1,51	,22
Shuttle run 4x10 m	13,52	1,15	12,87	1,10	78,14	**,00**
Three-minute step test (bmp)	131,17	18,65	128,67	19,28	4,22	**,04**

Discussion

Physical fitness is fundamental to public health. This has an influence on the risks of morbidity and mortality, and therefore can reduce these risks. Disease prevention and health promotion should be implemented as early as possible both in childhood and adolescence. Previous studies have focused on specific health behavior (Yen et al. 1997; Chen et al. 2003).

The results of our research point out that students from different residential status significantly differ in anthropometric measures, body composition and physical fitness levels. Male students who are studying in rural areas have lower systolic pressure, lower weight, lower percentage of body fat, body mass index and achieve better results in fitness test for assessing the strength and endurance of the arms and shoulder girdle, agility speed and have better cardiorespiratory capacity. Male students who are studying in urban environment show better results in fitness test for assessment of balance, speed of alternative movements and strength of the anterior stomach wall.

Female students who are studying in rural areas have higher average values of the systolic pressure, lower height, lower weight, lower percentage of body fat and show better results in fitness tests for assessing the explosiveness of the lower extremities, strength and endurance of the arms and shoulder girdle, strength of the palm grip, agility and speed and have better cardiorespiratory capacity. Female students who are studying in urban environment show better results in fitness tests for assessing the balance, speed of alternative movements and strength of the muscle of the anterior stomach wall.

The results from the previous researches that were conducted in Europe point that the children who live in urban environments are higher regarding their peers from the rural environments, while in many countries these differences stay in the mature age. The changes in the public health, nutrition and the life conditions which are connected to the urbanization are determined as reasons for the above mention (Bielicki, 1986).

The researches of Sandhu (Sandhu, 1983) in which there is comparison of the level of physical fitness in urban and rural environments at the district of Amritsar, point that the girls from the rural areas are superior at the physical fitness regarding the girls from urban area.

Mehtap and Nihal have conducted research in which they compared the level of the physical fitness in rural in relation to the urban children in Turkey and they found that the children who live in urban environment are higher, thicker and physically more inactive in relation to the children who live in rural environment (Mehtap and Nihal, 2005).

Tinazci and Emiroğlu explored the differences in the level of physical fitness among students from primary schools in urban and rural environment, between the ages of 9 and 11 years (Tinazci & Emiroğlu, 2010). The results from the research showed that the students from rural environments have better results in the tests for evaluation of the flexibility, endurance and strength. Badris and Petračias explored the level of physical fitness among students, both from urban and rural environment in Croatia. The analysis of the results of the students from different residential status in Croatia shows that the students in rural environments achieve better results in the tests for flexibility, whereas in the other tests there are no significant statistical differences (Badrića & Petračića2007). Eiben and the collaborators explored the influence of socio-economic status upon the phenomena of the biological acceleration among children in Hungary at the age of 3-18 years. The explorers came to a finding that the number of the members of family and the living place has influence onto the anthropometrical measurements. The children, who belong to families with larger number of members, were shorter, thinner and have lower percentage of body fat - in average values. Unlike them, the children from the urban parts of Budapest were higher, thicker, have larger thorax and shinbone and larger percentage of body fat (Eiben et. al. 2004).The research, which was conducted in Berlin (Pfister, G, & Reeg, A. 2006) on a sample of students at third and fourth grade from different social environment and different social inheritance, points out that the level of physical fitness is somehow conditioned by the social factors. The different social environment is stipulated as a reason for the differences in the level of fitness, but still it should be considered that the differences might be consequence of the differences in the offered content.

The larger presence of the sedentary way of life, especially among children who live in urban environment, decreases the total physical activity and at the same time it decreases the level of physical fitness and accomplishments. The results of our research show that adolescents who are studying in the rural environment achieve better results in tests for assessing physical fitness in which dominate the energy component, while adolescents from the urban environment achieve better results in the fitness tests in which dominates the information component (flamingo and palm tapping).

The assumption that the adolescents from rural environment have more spontaneous physical activities in open area and they use the external terrains more often, unlike the children who live in urban areas which is probably the reason because the first ones achieve better results, especially at the abilities in which the energetic component is dominant. Certainly, despite the stipulated factors for the differences in the level of physical fitness among children, the teacher of physical education, the organization at the school and the education by the parents have great influence and are very important for the physical activity, their personal example and home education.

Conclusion

The results point out that boys from middle school age who are studying in rural areas have lower average values of the systolic pressure, lower height, lower weight, lower body fat, body mass index and they show better results in endurance in pull-ups, pin running 4x10 meters and three minute step test. Boys from the middle school age who are studying in rural areas show better results in the tests: flamingo, tapping with hand and raising the trunk in 30 seconds. Girls from the middle school age who are studying in rural areas have higher average values of the systolic pressure, lower height, lower body fat and show better results in fitness tests: flamingo, tapping with hand and raising the trunk in 30 seconds. On the basis of the achieved results it could be assumed that the environmental factors in different environments contribute to differences in the anthropological characteristics of the participants.

The reason for that is probably due to the fact that the children who are educated in rural environment have better conditions for games in open area, thereby they have larger spontaneous physical activity.

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REAGENT STRIPS ARE RELIABLE AND VALID MEASURE IN DEFINING STATUS OF (DE)HYDRATION AMONG MALE JUNIOR BOXERS

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(Original scientific paper)

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Abstract

The dehydration is a common weight-manipulating technique in boxing, which is already known as a serious health-threatening behavior. Investigations confirmed urine-specific-gravity (USG) as the most reliable and applicable indicator of the body hydration status. In this study we have investigated reliability and concurrent validity of the reagent strips Medi – Test Combi 10 (RSC) as a method for the evaluation of hydration in elite junior boxers. As a gold standard, refractometric measurement (RF) is used. The sample of subjects comprised 14 male junior boxers from Croatia and Germany (all national team members; 16,57±1,15 years; 67,33±14,97 kg and 176,14±7,98 cm). The RSC measurement was done by two examiners, while the urine sample was simultaneously used for RF analysis. The Sperman range correlations between evaluators was high for three variable BLR, pH SPU of the 10 parameters evidenced by RSC, namely RSC-SPU (r = 0.92). Since RSC-SPU was highly correlated to RF (0.85 and 0.84 for first and second examiner, respectively), this study confirmed appropriate concurrent validity of the RSC-SPU measurement in evidencing the dehydration-status of the junior boxing athletes.

Key words*: hydration status, body weight manipulation, weight category, concurrent validity, golden standard*

Introduction

Amateur boxing is Olympic sport in which athletes compete in a weight class categories defined by maximum allowed body mass during the competition (M. S. Smith, 2006). Currently ten weight categories in amateur boxing open wide spectra of opportunity for the manipulation with body mass. Traditionally boxers try to achieve fast body mass reduction using several harmful methods (Artioli et al., 2010). The basic intention is to classify in a lower weight category in attempt to get a psychological and physiological advantage over the lower, lighter and consequently weaker rivals (Franchini, Brito, & Artioli, 2012).

Acute dehydration assumed to be a major adverse effect associated with rapid loss of body mass in amateur boxing (Reljic, Hassler, Jost, & Friedmann-Bette, 2013). It is common known weight-manipulating technique already emphasized as a serious health-threatening behavior.

Although there is no clear consensus the findings about the effects of acute dehydration on sports performance, as far as health aspect is concerned, dehydration status is claimed a serious health-threatening behaviour, especially with adolescence athletes. Dehydration has been proven to negatively affect numerous of health-related parameters. Briefly, it can lead to acute cardiovascular dysfunction, negatively influence on androgen hormones, development and growth, reduced cognitive abilities, reduced bone density, development of intake disorders and bad nutritional status and negative mood influence (Hall & Lane, 2001; Roemmich & Sinning, 1997; M. Smith et al., 2001). Because of all mentioned health-threatening issues, there is a need for practical, confident, accurate and fast field test that will highlight health- threatening methods used in body mass manipulation.

Previous reports indicate refractometry measurement (RF) as a gold-standard in determination of the hydration status (Stuempfle and Drury 2003). Urine specific gravity (USG) is a measure of the ratio of urine density (concentration) according to density of distilled water. Urine specific gravity measurement normally ranges from 1,002 to 1,040 and it is used as an indicator of the hydration status among athletes (Stuempfle & Drury, 2003). It was included into NCAA university rules as a result of three tragic death cases in 1997 caused by dehydration (Stuempfle & Drury, 2003). Beside from the usage RF in the

hydration status assessment, reagent stripes (RSC) were also used. The results of research considering reliability and validity of (RSC) are controversial (Brandon, 1994; Guthrie, Lott, Kriesel, & Miller, 1987).

The purpose of this research is to assess reliability and concurrent validity of RSC compared with RF, for elite junior amateur boxers in a pre competitive period.

Material & methods

Participants

Fourteen elite amateur boxer, junior national team members of Croatia and Germany (age16,57±1,15; 67,35±14,95 kg ;176,14±7,98 cm, experience; 5,28±1.4) agreed to participate in our survey. All of them were national champions, and they regularly participate in international competitions. All participants were kindly asked not to consume medications or dietary supplements within 24 hours before measurement. Team managers of both national teams gave written acceptance for implementation of this study that was previously approved by Ethical Committee of Kinesiology Faculty of University of Split.

Variables

Besides anthropometric variables and sport experience, two methods for evaluation of hydration status were analyzed:

(1) measurement method USG via RF- Atago Pal 10s Tokyo, Japan (automatically integrated air temperature compensation);

(2) method of evaluation USG via (RSC) producer Medi- Test Combi 10 SLG Machery- Nagel, Germany.

Experimental procedures

Measurements were carried out as a part of preparation match between national teams of Croatia and Germany, thirty days before the official World Junior Championship opening in Sofia, Bulgaria. Two professors of kinesiology with previous experience in field testing, and student of kinesiology as a clerk, collected and analyzed data. Athletes didn't train 24 hours before sampling and they were asked not to consume any medications or some other dietary supplements. Body mass was measured by official Tanita scale BC 520 (correctness of results is 0,1 kg), body height was measured by anthropometer according to Martin. Urine sample of 60 ml was collected in appropriate plastic container for urine between 8:00 and 8:30 a.m., before food and drink intake. RF read urine specific gravity in a range from 1,000 to 1,040, and deflection in a scale was 0,001. RF was calibrated with distilled water before usage. RSC contains variable of specific urine gravity distributed on a scale from 1 to 7 with coloured square and deflection of 0,005. While testing stripes (RSC) were dipped in urine, and values are read within 45-60 seconds. RSC values had been firstly read by two examiners and individually written, and after that they took RF finding. Urine sample is inflicted by a glass dropper on the instrument RF Atago Pal 10s and values were digitally read after that. Once the values had been written on the data sheets, the urine sample was regularly deposited.

Statistical analysis

Descriptive statistic parameters were calculated (the arithmetic mean and standard deviation). For determining reliability among evaluators for reagent stripes (RSC) Sperman range of correlation was used. Concurrent validity was analyzed through the Sperman's range of correlation between RSC and RF findings.

Results

The analysis of reliability among evaluators via Spearman's range indicates statistically significant correlation in variables: BLOOD; BILIRUBIN, PROTEINS, GLUCOSES; pH; USG; LEUKOCYTES. Only measurements of BILIRUBIN, pH and USG (correlation higher than 0.71) can be considered as reliable (Table 1).

Table 2 shows descriptive data; the results on RSC for both measurers. The mean results on RF were1,025±0,007.

Table 1. Analysis of reliability measured by reagent stripes – The Spearman's correlation among evaluators

	BLO2	URB2	BLR2	PROT2	GLU2	pH2	SPU2	LEUK2
BLO1	1.00							
URB1		-0.11						
BRL1			0.72*					
PROT1s				0.41				
GLU1					0.68*			
pH1						0.73*		
SPU1							0.92*	
LEUK1								0.68*

Legend 1: BLO-blood; UBR-urobilinogen; BLR-bilirubin; PROT- protein; GLU- glucose; pH; STU-specific urine gravity; LEUK –leukocytes; 1 – the first evaluator; 2 – the second evaluator;
** Significant values at level p < 0.05;.*

Table 2.Descriptive statistic among evaluators (AS – arithmetic mean; SD –standard deviation)

	EVALUATOR 1		EVALUATOR 2	
	AS	SD	AS	SD
BLO	1.07	0.27	1.07	0.27
URB	1.07	0.27	1.14	0.36
BLR	1.86	0.53	2.07	0.83
PROT	1.50	0.52	1.14	0.36
NIT	1.00	0.00	1.00	0.00
KET	1.00	0.00	1.00	0.00
GLU	1.07	0.27	1.14	0.36
pH	2.00	0.78	2.21	0.70
SPU	5.14	1.17	5.29	1.27
LEUK	1.07	0.27	1.14	0.36

Legend 2: variables RTMedi –test Combi 10m BLO-blood; UBR-urobilinogen; BLR-bilirubin; PROT- proteins; NIT-nitrite; KET-ketones; GLU- glucoses; pH; STU-specific urine gravity; LEUK –leukocytes

Table 3.Analysis of concurrent validity of reagent stripes (RSC) compared to RF finding – Correlation of Spearman analysis

VARIABLES	REFRAKTOMETER
GLU1	0.07
GLU2	0.25
USG 1	0.85*
USG 2	0.84*

Legend 3: GLU1- 1.evaluator in glucose variables; GLU2 – 2. evaluator in glucose variable; PROT1- 1.evaluator in protein variable; PROT2- 2. evaluator in protein variable; SPU1- 1.evaluator in variable of SPU; USG2- 2.evaluator in variable of SPU;
** Statistically significant ranges of Spearman correlation on the level p< 0.05*

Concurrent validity was satisfying for variable SPU, because the Sperman range correlation of both evaluators with RF finding was high (73 % common variance) (Table 3).

Discussion

Reliability of measurements RSC in variable of SPU relates strong agreement between evaluators. Because of categorical nature of collected data, Spearman's range of correlation was used as a measure of reliability. Studies done so far have shown contradictory research findings in relation to RSC reliability as measure of specific urine gravity. Earlier studies emphasized high correlation coefficient between evaluators RSC (r =0,90; r =0,88), (Gounden & Newall, 1983), (Guthrie, 1987). Recent researches reported poor or medium correlation coefficient (r =0.72 ; r=0.66; r =0.51), and low intraclass correlation coefficient (ICC=0,57) between evaluators that evaluated specific urine gravity via RSC (Brandon, 1994). As the main reason of relatively poor reliability, authors emphasize visual analysis and subjective

interpretation of changes in coloured RSC during chemical reaction with urine (Stuempfle & Drury, 2003). They also underline lack of extremely dehydrated participants which reduced variability of results (Stuempfle and Drury 2003). In our research, extremely dehydrated participants were evaluated (RF 1,025±0,007) and consequently the high level of reliability is shown. The possibility of technology improvement shouldn't be excluded in produce of RSC, because referent studies are between ten and twenty years old.

Although there are a lot of papers about reliability of RSC; studies which dealt with concurrent validity RSC in relation with RF are rare. Authors who have researched this problem have established weak or average validity RSC in relation with RF finding (Stuempfle & Drury, 2003). Data in our study have shown satisfactory concurrent validity in variable SPU. The causes of the contradictory research findings of our study compared to results of previous studies may be partly speculated, but it is probably caused by magnitude and prevalence of variability among results in variable SPU in our research (considering extreme dehydration), which was not the case in previous study (Stuempfle & Drury, 2003)

Measure's scale of RSC stripes is from 1 to 7 (deviation 0,005; RT), while RF digitally shows result (deviation 0,001; RF). Recent researches (mentioned in the discussion) about establishment of reliability of RSC are omitted in differences between ratio (RSC) and interval (RF) measurer's scales in which collected data are read. The differences between methodologies – statistical approach in data processing may also be one of the reasons for disharmony of researches' findings.

Conclusion

The result of these analyses is a hypothesis about appropriate reliability and concurrent validity of RSC in the field testing of the hydration status. Undoubtedly, there is a need for fast, cheap, reliable and valid field test of boxers' hydration status. RSC can be used in practice, especially because of health threatening issue caused by uncontrolled reduction of body weight during the competitive season.

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ACUTE EFFECTS OF DIFFERENT WARM-UP PROGRAM ON FLEXIBILITY PERFORMANCE

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796.015.52
(Original scientific paper)

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Abstract

The athletes use different means and methods, in order to prepare for the activities or contests that follow. Different methods of warm-up, in the form of static and dynamic stretching, increase the amplitude range of motion, reduce muscle tension, are used for the prevention of injury and improve circulation. On the sample of 25 adult males, students of the Faculty of Sport and Physical Education, age 19 ±6 months, the effects of different warm-up methods were investigated. Manifestation of flexibility measured with a 6 motor tests. The aim of this study was to determine differences in the manifestation of flexibility depending on the applied static and dynamic methods of preparation for the work. The differences were determined by t-test for paired samples. The results show a statistically significant difference in range of motion after the static and dynamic stretching, and observed acute effects on increasing flexibility. There was no statistically significant difference in range of motion of joints after application of static and dynamic stretching methods on the sample.

***Key Words*:** *static stretching, dynamic stretching, range of motion of joints*

Introduction

Flexibility is a basic motor skill and represents an ability of a man to perform motion with full amplitude of movement in joints. It can be said that it depends on the mobility of the joints and the elasticity of the muscles. A range of factors affect the level of flexibility, such as: age, time of day, temperature, fatigue, fitness, sex, while influence of warm-up is of a particular interest for this study. Warming-up aims at increasing the temperature of muscles which will be engaged in physical activity. Stewart & Sleivert (1998) found that skin temperature increases rapidly after 5 to 10 minutes of warm-up. According to this, it is assumed that warm-up exercises increase the temperature of the skin, as well as body temperature, and thereby increase the effect of the muscle stretching.

Performing stretching during warm-up represents preparing of the body for the activities that follow. Stretching is commonly used to increase the range of motion in the joints (Ferber,Ostering & Gravelle, 2002; Harvey, Herbert,& Crosbie, 2002). There are various speculations regarding when to implement the stretching within the musculature warm-up. Maffetone (1999) states that stretching should be carried out during the main part of the training, while O'Connor & Hurley (2003) conclude that it should be carried at the end of the training, because it causes a state of relaxation which is not desirable at the beginning of a training.

The combination of warm-up and static stretching at the beginning of training significantly increases the mobility of knee joint for 10.3° (extension of knee in straight-leg forward), ankle (plantar flexion of foot is increased) and lumbar spine (De Weijer, Gorniak, & Shamus, 2003; Beedle & Mann, 2007). Static stretching as an independent method of warm-up at the start of training produces statistically significantly better effects on the mobility of joints than dynamic stretching (O'Sullivan, Murray,& Sainsbury, 2009). Opposite results were obtained by Aguilar et al. (2012). Authors suggest that the dynamic method of warm-up at the start of training achieved better effect on the mobility of joints compared to static warm-up. Different results suggest that further analysis is needed.

Subject of research are the effects of different warm-up methods (static and dynamic stretching) in the introductory part of the class on the flexibility of the participants. The aim of the study was to determine

the acute effects of different warm-up methods (static and dynamic stretching), the maximum range of motion (ROM) in certain joints (hip, shoulder, hands and feet) in participants. Then, to determine whether there is a difference between the ranges of motion after application of static and dynamic stretching.

Material & methods

Participants

The sample consisted of 25 male students of the Faculty of Sport and Physical Education in Novi Sad, aged 19 years ± 6 months. Testing took place during regular school classes on the course of Anthropomotorics in the hall of the Faculty. Microclimate suited test conditions. All participants agreed to voluntarily participate in the experiment and were informed in advance of the experimental protocol described below.

Procedure

Static stretching as a form of warm-up (SS) consisted of 6 exercises. The exercises focused on muscle groups that comprise the joint for which the maximum range of motion was measured. Each exercise took 1 x 30 seconds. Exercises performed were: 1) Lifting right leg on the bench, arms up; 1-lateral circle forward, deep forward bend; 2) Perpendicular position with both feet, arms up; 1-deep forward bend; 3) Small straddle position, forearms leaned against a wall, dorsal flexion of the foot; 4) Front lying position, arms against the body; 1-arms behind the body; 5)Sitting with both feet, arms forward (bat in hands), palms placed slightly wider than shoulder width; 1-arms up; 6) Kneeling with hands on the ground, fingers facing knees, thumbs out ; 1-leaning backward, keeping your palms on the ground.

Dynamic stretching as a form of warm-up consisted of the same exercises. Each exercise was repeated 12 times.

Test protocol

Maximum ranges of motion (ROM) in certain joints (hip, shoulder, hands and feet)was measured in students at the beginning of the class, and then again immediately after static stretching as warm-up method. After 5 days, the same procedure was applied, but the participants practiced dynamic stretching method.

Instruments

Flexibility of the participants was measured by motor tests: straight-leg forward from lying on the back (SFB) – hip joint; forward bend on the bench (DB); dorsal flexion of the foot (DFF); lying anterior on the Swedish box, arms behind the body (ABBL); sitting on both feet with arms up (AUS); dorsal flexion of wrist (DFW). The maximum range of motion of the wrist, which was manifested in motor tests, was measured by goniometer except in the case of forward bend on the bench.

Statistical analysis

Kolmogorov-Smirnov test for normality of the distribution shows that the results at the initial measurements, after static and dynamic stretching are normally distributed ($p>0.05$). The differences between the initial and final measurements (after static and dynamic stretching) were determined by T-test for dependent samples. The difference between the final measurements (after static and dynamic stretching) was also determined by T-test for dependent samples, and also between the differences obtained.

Results

Table 1 shows the results of the differences between the initial measurements and immediately after static stretching as a method of warm-up.

Table 2 shows the results of the differences between the initial measurements and immediately after dynamic stretching as a method of warm-up.

Table 3 shows the results of the differences between static and dynamic stretching as a method of warm-up in participants.

Table 4 shows the differences between the obtained differences between the initial measurement and after static stretching, and also between the initial measurement and after dynamic stretching. For each

participant the difference was calculated by subtracting the results obtained at the initial measurement of the results achieved after static or dynamic stretching.

Table 1 The difference between the initial and final measurements (after static stretching)

Variables	AS_1	AS_2	r	t	p
SFB (°)	84,68	91,31	0,00	-5,31	**0,00**
DB (cm)	48,24	51,96	0,00	-5,43	**0,00**
DFF (°)	47,32	53,00	0,00	-4,42	**0,00**
AUS (°)	195,88	206,28	0,00	-4,44	**0,00**
ABBL (°)	82,80	93,36	0,00	-6,77	**0,00**
DFW (°)	108,24	109,68	0,03	-0,61	0,54

Legend: AS1 - arithmetic mean of the initial measurement; AS2 - arithmetic mean after static stretching, r - the statistical significance of the Pearson correlation coefficient ($p<0.05$), t - value of t test; p - statistical significance of the t - test ($p<0.05$)

Table 2 The difference between the initial and final measurements (after dynamic stretching)

Variables	AS_1	AS_2	r	t	p
SFB (°)	84,68	91,56	0,00	-6,46	**0,00**
DB (cm)	48,24	52,08	0,00	-6,13	**0,00**
DFF (°)	47,32	51,72	0,00	-3,58	**0,00**
AUS (°)	195,88	201,80	0,25	-2,52	**0,01**
ABBL (°)	82,80	93,50	0,00	-6,35	**0,00**
DFW (°)	108,24	110,24	0,20	-0,78	0,44

Legend: AS1 - arithmetic mean of the initial measurement; AS2 - arithmetic mean after dynamic stretching, r - the statistical significance of the Pearson correlation coefficient ($p<0.05$), t - value of t test; p - statistical significance of the t - test ($p<0.05$)

Table 3 The difference between the results of static and dynamic stretching

Variables	AS_1	AS_2	r	t	P
SFB (°)	91,32	91,56	0,00	-0,22	0,82
DB (cm)	51,96	52,08	0,00	-0,27	0,78
DFF (°)	53,00	51,72	0,00	1,59	0,12
AUS (°)	206,28	201,80	0,00	1,81	0,08
ABBL (°)	93,36	93,52	0,00	-0,58	0,56
DFW (°)	109,68	110,24	0,00	-0,13	0,89

Legend: AS1 - arithmetic meanafter static stretching; AS2 - arithmetic mean after dynamic stretching, r - the statistical significance of the Pearson correlation coefficient ($p<0.05$), t - value of t test; p - statistical significance of the t - test ($p<0.05$)

Table 4 The difference between the obtained differences at the initial and final measurement (after static and dynamic stretching) on a given sample

Variables	AS_1	AS_2	r	t	P
SFB (°)	6,24	6,88	0,00	-0,61	0,54
DB (cm)	3,68	3,76	0,00	-0,17	0,86
DFF (°)	5,68	4,40	0,00	1,59	0,12
AUS (°)	10,40	5,92	0,00	1,81	0,08
ABBL (°)	10,56	10,72	0,00	-0,13	0,89
DFW (°)	1,44	2,00	0,00	-0,58	O,56

Legend: AS1 - arithmetic meanafter static stretching; AS2 - arithmetic mean after dynamic stretching, r - the statistical significance of the Pearson correlation coefficient ($p<0.05$), t - value of t test; p - statistical significance of the t - test ($p<0.05$)

Discussion

The analysis of Table 1 shows that there is a statistically significant difference ($p<0.05$) between the initial measurement and after static stretching as a form of warm-up, in the ROM at the hip, shoulder and ankle joint. Regarding wrist, no statistically significant difference was obtained between the initial

measurement and after static stretch. By interpretation of the t-test it can be observed that in all the variables (SFB, DB, DFF, ABBL, AUS and DFW) better results were obtained during the second measurement (after static stretching). ROM of the hip joint after static stretching was increased in average for 6.63º. These results are in line with the results obtained by Harvey, et al. (2002); Davis, Ashby, McCale, McQuain,& Wine (2005). The authors believe that static stretching for 30 seconds significantly increases the range of motion of the knee joint and the hip in a short period of time. Harvey, et al. (2002) in a review of the literature suggest that ROM in joints increases after static stretching by 8°. Opposite results were obtained by Aguilar, et al.(2012) who concluded that static stretching does not show significant acute effects on increasing ROM at the hip joint. Their experimental protocol, and the method of testing is different from the procedure specified in this document, and it is difficult to compare the results. Radford, Landorf, Buchbinder,& Cook (2007) reported that static stretching of muscles at the beginning of training increases flexibility of dorsal flexion of the ankle joint, which is contrary to the results obtained in our study($p>0.05$).

The analysis of Table 2 shows that there is a statistically significant difference ($p<0.05$) between the initial measurement and after dynamic stretching as a method of warm-up regarding the maximum range of motion in the hip, shoulder and ankle joint. Regarding the wrist joint no significant difference was obtained between the initial measurement and after dynamic stretching ($p>0.05$). Dynamic stretching is observed to increase ROM in the hip, shoulder, ankle and wrist joint. Samson, Button, Chaouachi,& Behm (2012) explored the dynamic and static stretching during warm-up and the results show that the dynamic method increases flexibility by 4.27° but not as good as static method, where the increase is 11.42°. Turki-Belkhiria, et al.(2014) found that there is a lack of research on the dynamic stretching and its acute effects on the ROM of the joints. The authors used two methods of stretching: active dynamic stretching (ADS) and passive dynamic stretching (PDS) in an experiment that lasts 8 weeks. The results show that ADS and PDS cause similar effects in improving flexibility (ADS 45, 1 %, PDS 57, 6 %).

Interpretation of Table 3 shows that there is no statistically significant difference in the ROM of the hip, shoulder, wrist and ankle joint between static stretching and dynamic, as warming-up methods. Results coincide with the results obtained by Beedle & Mann (2007); Perrier, Pavol,& Hoffman, 2011.

By analyzing Table 4 it can be seen that there is no difference between the obtained differences between the initial measurement both after static stretching and after dynamic stretching, regarding the maximum range of motion of joints.

Conclusions

Stretching (static and dynamic) as a method of warming-up leads to an increase in the maximum range of motion in certain joints (hip, shoulder, ankle and wrist joints). When warming-up at the beginning of the class, it is not essential which method of stretching (static or dynamic) will be practiced because both methods generate the same acute effect on the mobility of the joints. Since we have obtained the same acute effects on the flexibility of the participants, it is necessary to pay attention to how stretching as a warming-up method affects the activities that are practiced in the main part of the class or training. Static stretching as a method of warming-up leads to passive muscle relaxation due to reduced neural activity, resulting in a decrease of physical activities in which muscular strength, speed and power are exhibited (Evetovich, Numan, Conley,& Todd, 2003). In contrast to the static, dynamic stretching during warm-up causes an increase in body temperature along with greater neural activity. Muscles are warmed-up through movement, which will allow better demonstration of skills during the activity that follows. Fatigue must be avoided during dynamic stretching, as it will affect the ability of the muscle to generate sufficient force during the relevant activities, and will cause reduction of the elastic capabilities of muscle. New research and results dealing with stretching and warm-up are necessary so through implementation in the form of the periodization plan of sport training and competition, expected results could be reached.

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THE DIFFERENCES BETWEEN JUMP PERFORMANCE AND SPEED OF YOUNG FOOTBALL PLAYERS WITH DIFFERENT LEVELS OF COMPETITION

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(Original scientific paper)

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Abstract

The explosive strength is the capability to perform a jump, to perform a hard blow, and to perform and to create one fast and strong movement, which is momentary. The aim of research was to determine differences in the explosive strength, jump performance and speed between football players with different levels of competition (aged 10 to 12 years). The sample of research were 20 football players of federal level (age 11,31±0,62; height 153,93±7,94 cm; weight 43,18±6,91 kg) and 20 football players of regional level (age 11,05±0,49; height 150,39±8,14 cm; weight 43,13±7,72 kg). The sample of the variables represented six tests of explosive strength - jump performance: standing long jump, triple jump, countermovement jump and speed: sprint on 10m, 20m and 30 m. The results were determined by T-Test for small independent causes. Based on the results, we conclude that there are significant differences between football players with different levels of competition in all variables, and this difference is defined as significantly better results in all tests in favor of the football players with federal level of competition. After processing and the data obtained it can be concluded that the federal league coaches pay more attention to the development of explosive strength and speed than regional rank coaches.

***Key Words**: explosive strength, federal league, regional rank, football players, the difference*

Introduction

Soccer is one of the most widely played and complex sports in the world, where players need technical, tactical, and physical skills to succeed (Joksimović et al., 2009). Soccer is an anaerobic-aerobic sport with alternating phases of high loads such as sprints, quick change of direction, jumping, and sudden stops. Football is characterized by a continuous course of activities with intermittent intensity of a game and a very low success ratio (the number of achieved goals) according to a possession of a ball (Reilly et al., 1993). Research indicates that performance in soccer depends on various physical qualities and skills including tactical and technical skills as the two most import factors affecting performance in soccer (Bangsbo, 1994; Reilly,Bangsbo,& Franks,2000). Some exposure to game skills is necessary at an early age, since Elliott et al., (1980) reported that movement and muscle activity patterns in young soccer players were evident by age of 11. The period of life before adolescence is critical for the acquisition by young soccer players of many physical and technical features. During the course of prepubertal development, running speed, resistance and strength improve (Armstrong & Welsman, 2001; Beunen et al., 2002). Research on talented young athletes often focuses on comparisons between youth and professional players and players classified by competitive level or expertise at a certain stage of development (Reilly, Williams,Nevill& Franks,2000). Remarkable changes are occurring on the skeletal and muscular apparatus of the lower limbs, which is related to the specificity of the load it puts on players. Football players are therefore characterized by strong leg and lower leg bones. Other studies not only support this assumption but also claim that physical capabilities such as strength and running speed must be well developed to reach a high performance level in soccer (Hoff, 2005; Little& Williams, 2005). During a soccer match, lower body power is important for executing different activities as stopping and changing running speed as well as direction (Hoff &Helgerud, 2004; Thorlund, 2009). In particular, muscle strength of the lower limbs is significantly associated with vertical jump height and sprinting performance (Wisløff, Castagna,Helgerud, Jones& Hoff,2004). Vertical jumps, hops, and/or bounding

movements are often used to increase explosiveness and strength of the lower extremities (Ebben, 2005; McNeely, 2005). The Countermovement Jump (CMJ) represents a plyometric exercise for the lower body. In terms of lower body exercises, vertical jump movements have been systematically used in order to explain sprint performance (Cronin & Hansen, 2005; McBride,Triplett-McBride,Davie& Newton, 2002). Soccer game analyses on male elite players indicate that the players sprint between 1–11% of the total game time on high speed (Stølen, Chamari, Castagna& Wisløff,2005). Furthermore, the duration of the sprints is normally between 2 and 4 seconds, but the duration varies according to the role and position of the player (Reilly, Bangsbo,& Franks,2000; Vanderford et al., 2004). The aim of research was to determine differences in the explosive strength, jump performance and speed between football players with different levels of competition (aged 10 to 12 years).

Methods

The sample of research were 20 football players from the football club "Radnički" from Niš who compete in the federal level (age 11.31±0.62; height 153.93±7.94 cm; weight 43.18±6.91 kg) and 20 football players from the football club "Palilulac" from Niš, who compete on the Serbian regional level (age 11.05±0.49; height 150.39±8.14 cm; weight 43.13±7.72 kg). All the players had more than 2 years of experience. The players were fully-informed of all the experimental procedures. All subjects agreed to the trial and during this period were clinically healthy. All tests were performed on an outdoor grass pitch. Each player performed a standardized 15-minute warm-up consisting of general movements and dynamic and static stretching. After the general warm-up, the players performed all required test. The sample of the variables represented six tests of explosive strength - jump performance: long standing jump, triple jump, Countermovement Jump and speed: sprint on 10m, 20m and 30 m.

Standing long jump (LJ) - The standing long jump assessed explosive leg power. It was performed as a two-foot takeoff and landing. The takeoff was from behind a line on the grass. The subjects jumped as far as they could and they were allowed the use of countermovement with the arms and legs. The distance from the takeoff to the point where the nearest heel touched the grass was measured in centimetres, and the best of three jumps was recorded, with a recovery of approximately 3 minutes between trials.

Triple jump (TJ) - The takeoff was from behind a line on the grass.The players reflect both feet first, land on one foot, then the other leg and finally land on the grass with both feet. Three trials were completed for each participant, separated by a 3 min rest interval.The distance from the takeoff to the point where the nearest heel touched the grass was measured in centimetres. The best of three jumps was recorded.

Countermovement Jump (CMJ) - The participants were asked to perform five vertical jumps (CMJ), with their hands placed on their hips in order to minimize arm contribution to leg extensor assessment. The CMJ was measured by a wireless accelerometer Myotest (Sion, Switzerland), positioned safely on a belt, which the participants carried around their lower trunk. The CMJ protocols included the following technique: from the initial position, normal standing position (on both legs) and hands placed on their hips, through the flexion in the knee joints up to 90º, after the audio signal from the device, the participants performed the maximum vertical take-off, and landed with affable flexion (up to 110º) in the knee joints and finally, went back to the starting standing position, while waiting for the new sound signal, when the specified jump technique was repeated. The device tested different variables that are important determinants of explosive strength performance. For the purposes of our study, we took the variable Height (expressed in cm) as the most competent parameter.

Speed - sprint on 10m, 20m and 30m - The sprint performance of players was evaluated from a standing start over distances of 10, 20 and 30m. On command, subjects sprinted from a standing position. Three trials were completed for each participant, separated by a 3 min rest interval, and the best trial was used for the subsequent statistical analysis. Speed was measured to the nearest 0.01 second.The tests were performed from a standing start and measured by means of infrared photocells Uno Lux (The Republic Institute for Sports, Belgrade, Serbia).

All results have been analyzed in the statistical program Statistics 20.0. For all variables basic parameters of the descriptive statistics were calculated: the minimum score (Min), maximum score (Max), mean (Mean), standard deviation (Std. deviation). To determine a statistically significant difference between the groups for each variable was used a T - test, where for the statistical significant difference the value of the significance level to 0.05 ($p \leq 0.05$) was taken.

Results

Table 1 - Descriptive Characteristics of performance - federal level

	Min	Max	Mean	Std. deviation
LJ	0.84	1.50	1.158	.116
TJ	4.87	6.13	5.450	.376
CMJ	28	33	31.33	2.082
10m	2.22	2.76	2.517	.134
20m	3.53	4.45	4.037	.211
30m	5.1	5.89	5.554	.193

Table 2 - Descriptive Characteristics of performance - regional level

	Min	Max	Mean	Std. deviation
LJ	0.7	1.45	1.025	1.015
TJ	4.22	5.52	4.845	.395
CMJ	22	29	25.77	2.619
10m	2.35	3.45	2.822	.313
20m	3.89	5.12	4.475	.407
30m	5.45	6.7	5.958	.358

In tables 1 and 2 there are descriptive characteristics given on performance for the regional and federal players. Analyzing both tables, it can be observed that the value of basic, central and dispersion parameters in the intervals of minimum and maximum results, do not contain five or more standard deviation (STD) for any of the variables, based on which their sensitivity can be noticed.

Table 3 - The significance of the differences between groups - jump performance

		Mean	Std. deviation	T	p
LJ	federal	1.158	.116	2.320	**.026**
	regional	1.025	1.015		
TJ	federal	5.450	.376	4.962	**.000**
	regional	4.845	.395		
CMJ	federal	31.33	2.082	3.408	**.004**
	regional	25.77	2.619		

Table 4 - The significance of the differences between groups - speed

		Mean	Std. deviation	T	p
10m	federal	2.517	.134	-4.000	**.000**
	regional	2.822	.313		
20m	federal	4.037	.211	-4.267	**.000**
	regional	4.475	.407		
30m	federal	5.554	.193	-4.434	**.000**
	regional	5.958	.358		

The results of the T-test in tables 3 and 4indicate a statistically significant difference between the federal league and regional rank players aged 10 to 12 years in six tests of explosive strength, thereby, the

difference in all tests is in favor of the federal level players. The biggest difference between the players is in all speed test 10m (.000), 20m (.000), 30m (.000) and jump performance triple jump TJ (.000).

Discussion

Muscle strength and speed are important physiological characteristics of soccer players needed to perform sprinting, jumping, tackling, and kicking in a soccer game (Reilly, Bangsbo& Franks, 2000). The results of this study show that federal level young soccer players presented higher results in standing long jump, triple jump, Countermovement Jump and speed time on 10m, 20m and 30m than regional level young soccer players. The current research showed a statistically significant difference between the federal league players and regional rank players in jump performance. To same was also concluded by Gravina at al., 2008. The jumping ability of federal level soccer players is significantly higher than the ability of the soccer players of regional levels (Gissis at al., 2006). Vertical jump tests can determine muscle power of the lower limbs (Cronin & Hansen, 2005; Reilly, Williams, Nevill, &Franks, 2000). A previous study has shown significant differences in vertical jump height among soccer players of different competition levels (Reilly, Williams, Nevill&Franks, 2000). In our study federal level players were faster than regional level players in all speed tests. In fact, although sprinting time in a soccer match only represents 8-13% of the whole time (Vaeyens,Philippaerts & Malina,2005), these high-intensity runs may be decisive for winning the match. According to Valquer,Barros & Sant'Anna(1998) 96% of the sprint bouts performed during a soccer match are shorten than 30 m, with 49% being shorter than 10 m. Stølen, Chamari, Castagna& Wisløff(2005) stated that 10-m time-trial performance should be used as a relevant evaluation in modern soccer. Federal young soccer players also run faster over 10 m than regional soccer players. Reilly, Williams, Nevill&Franks (2000) have reported significant differences in sprint performance between soccer players who played for international clubs and local clubs. The improvement in the speed of athletes is very difficult, yet, possible and running speed is related to power (Cardinale&Wakeling, 2005; Delecluse, Roelants&Verschueren, 2003). Results of the present study suggest the possibility that regional coaches choose players for immediate competitive needs and not necessarily for eventual success at higher levels of competion.

Conclusion

The results of our study support previous investigations indicating differences in the explosive strength, jump performance and speed between football players with different levels of competition. In conclusion, the findings of the present study suggest that the federal young soccer players can be distinguished from regional young soccer players in strength and speed characteristics. These strength and speed measures may provide useful information for attaining high soccer level and designing and evaluating training programs. This information could be useful for practitioners to monitor their strength training programs in order to improve jump and sprint performance at young football player age 10-12 years. Training in Serbian soccer clubs has the same universal goal as everywhere else: to maximize the performance level of each individual player, regardless of their predictable potential in the future. The future researches should be based on the differences between young football players of federal and regional level of competitions with different ages, but also on the positions in the team.

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RELATION BETWEEN BASIC MOTORIC TESTS AND JUDO TECHNIQUE – YOKO TOMOE NAGE

UDC:796.853.23.012:061.237(497.711)
(Original scientific paper)

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Abstract

The research covers 60 athletes – judokas at the age of 15 to 17. Total of 18 motoric tests as a predictor variable set were applied to the respondents. They were hypothetically used for evaluation of the motor abilities: segmental speed, flexibility, explosive strength, repetitive strength, balance and coordination. Yoko tomoe nage technique was applied as criterion variable. The aim of the research was to determine the prediction of the criterion system of motor variables on specific situation-motor variable yoko tomoe nage. Obtained results are processed and basic statistical parameters and linear regressive analysis is given. The conclusion based on the obtained results is that high and statistically significant prediction is determined between the predictor set of motor variable and specific situation-motor variableyoko tomoe nage. Partial impact on prediction of criterion variable yoko tomoe nage is determined among the representatives for assessment of: shoulder flex, explosive strength of lower limbs and explosive strength of upper limbs.

Key words: *motor abilities, specific motor abilities, prediction, judokas.*

Introduction

In the early 20th century, judo in Japan became fundamental and compulsory in physical education. In a very short time period, sensei from Japan spread the judo throughout the world, and it became very popular, especially in Europe and USA. The founder of judo, Jigoro Kano, claimed that judo would not be complete without the two basic axioms: 1. Maximum efficiency with minimal effort and 2. Mutual welfare and benefit. Practicing these two basic axioms leads to the true values of judo. Connection between basic-motor tests and specific situation-motor tests has been researched by many authors: Sertic, H., Vuleta, D. (1997); Zeljkovic, et al. (2012); Krstulović, S. (2012);Mickoski, G., Kostovski, Z. (2013); Mickoski, G., Kostovski, Z. (2014). Other authors in their research compared the results obtained from the basic-motor tests and specific situation-motor tests among two groups of respondents. One of them is the research of Kostovski, et al. (2012).

Based on the previous conclusions, the aim of the research was to determine the prediction of criterion system of motor variables on specific situation-motor variable yoko tomoe nage.

Methods

The research covers 60 judokas at the age of 15 to 17, judokas with competitive experience in cadet category at the national competitions. Respondents included in the sample are judokas from the following 10 judo clubs in the Republic of Macedonia: JCIpon– Skopje, JC Kodokan– Skopje, JC Mioki– Skopje, JC Ilinden – Skopje, JC Seishin– Prilep, JC Prilep– Prilep, JCProleter– Prilep, JCPelister – Bitola, JCSensei – Radovish and JC Kozhuvchanka – Kavadarci. In the research, total of 18 motor tests as a predictor variable set and Yoko tomoe nage technique as criterion variable were applied to the respondents.

Predictor variables were hypothetically used for evaluation of the motor abilities of the athletes – judokas and three tests by the methodology of Kurelić, et al. (1975), Metikoš, et al. (1989) and Kostovski, R. Z. (2004) per each motor space were used:

For the segmental movement speed assessment: Hand Tapping for 10 seconds (MTAPR10), Foot Tapping for 10 seconds in a frontal plane (MTAPNFR10) and Foot Tapping for 10 seconds in a sagittal plane (MTAPNSR10).

For the flexibility assessment: Deep forward bend on a bench (MPRKL), Shoulder flex with bat (MISP) and Man split (MSHPM).

For explosive strength assessment: Standing long jump (MSDM), High jump from a spot (MSVM) and Throwing a medicine ball forward in a supine position (MFMLGN).

For repetitive strength assessment: Raising body from a back lying position (MPTLG), Raising body from lying on stomach (MPTLS) and Push-ups on the floor (MSKP).

For balance assessment: Balance on inner hemisphere (MRPTV), Balance on external hemisphere (MRPTN), Balance on external hemisphere with eyes closed (MRPTNZO).

For coordination assessment: Agility in the air (MOVV), Agility with a bat (MOSP) and Agility on the ground (MOKTLO).

While specific situation-motor variable Yoko tomoe nage was applied as criterion variable. (Kudo, 1976).

Results and Discussion

The first table (Table 1) shows basic descriptive statistical parameters among judokas-respondents (N=60). For the purpose of this research, the following parameters were calculated: arithmetic mean (Mean), minimal result (Min), maximal result (Max), standard deviation (Std. Dev.).

Table 1 – Descriptive statistical parameters of Basic-motor abilities

	Mean	Min	Max	Std.Dev.	Skew	Kurt	max D	K-S - p
MTAPR10	22,63	17,00	31,00	3,17	0,43	-0,27	0,13	p > .20
MTAPNFR10	13,73	10,00	19,00	1,84	0,41	0,12	0,12	p > .20
MTAPNSR10	11,42	8,00	15,00	1,67	-0,02	-0,59	0,12	p > .20
MPRKL	28,23	15,00	44,00	6,80	0,10	-0,55	0,08	p > .20
MISP	82,30	50,00	129,00	15,51	0,56	0,24	0,10	p > .20
MSHPM	178,08	148,00	203,00	11,44	0,11	-0,09	0,08	p > .20
MSDM	199,39	146,00	250,00	27,63	-0,12	-0,81	0,11	p > .20
MSVM	37,38	20,00	65,00	7,64	0,77	2,21	0,13	p > .20
MFMLGN	6,48	4,35	9,50	1,18	0,26	-0,52	0,08	p > .20
MPTLG	34,63	8,00	80,00	17,30	0,74	0,19	0,11	p > .20
MPTLS	43,37	6,00	101,00	23,33	0,54	-0,41	0,12	p > .20
MSKP	24,63	6,00	100,00	14,98	2,45	10,08	0,14	p < ,20
MRPTV	7,18	0,00	27,00	6,12	1,05	0,66	0,18	p < ,05
MRPTN	6,53	0,00	27,00	6,97	1,49	1,40	0,23	p < ,01
MRPTNZO	18,79	2,00	44,00	10,84	0,25	-0,95	0,11	p > .20
MOVV	5,19	3,37	7,57	0,96	0,52	0,17	0,10	p > .20
MOSP	10,13	5,10	20,10	3,04	0,89	2,07	0,09	p > .20
MOKTLO	18,97	12,00	33,00	4,71	0,94	0,49	0,13	p > .20

For testing normal distribution of results, the following were shown: the coefficient of asymmetry results (Skew), coefficient of elongation (flatness) of results (Kurt) and the Kolmogorov and Smirnov Method (maxD).

By analyzing the results obtained in this research and comparing them to the previously conducted researches, it can be concluded that obtained results are within the expected frames. The asymmetry of the results values (Skew) has statistically significant deviations in variables: Push-ups on the floor (MSKP, Skew = 2,45), Balance on inner hemisphere (MRPTV, Skew = 1,05) and Balance on external

hemisphere (MRPTN, Skew = 1,49). Flatness, that is the degree of the curvature of the top curve (Kurt), has statically significant deviation in the variable Push-ups on the floor (MSKP, Kurt = 10,08). Based on the results obtained by the coefficient of normal distribution of results (max D), it can be concluded that statistically significant deviation at the level of p < ,01 can be noted in the variable: Balance on inner hemisphere (MRPTN).

Table 2 Regressive analysis of the specific situation-motor variable Yoko tomoe nage and Basic-motor abilities

	r	Beta	Std.Err. - of b*	t(41)	p-value
Intercept				0,36	0,72
MTAPR10	0,21	0,19	0,14	1,33	0,19
MTAPNFR10	0,08	0,09	0,17	0,55	0,58
MTAPNSR10	0,09	-0,12	0,17	-0,71	0,48
MPRKL	0,11	-0,22	0,14	-1,58	0,12
MISP	-0,31	-0,30	0,12	-2,51	0,02
MSHPM	0,14	0,22	0,13	1,64	0,11
MSDM	0,41	0,57	0,15	3,67	0,00
MSVM	0,14	-0,10	0,13	-0,80	0,43
MFMLGN	0,05	-0,33	0,15	-2,24	0,03
MPTLG	0,27	0,14	0,20	0,68	0,50
MPTLS	0,10	-0,32	0,19	-1,75	0,09
MSKP	0,13	0,09	0,13	0,65	0,52
MRPTV	-0,29	-0,17	0,17	-1,03	0,31
MRPTN	-0,40	-0,21	0,18	-1,21	0,23
MRPTNZO	-0,16	0,01	0,21	0,04	0,97
MOVV	-0,29	-0,21	0,14	-1,55	0,13
MOSP	0,04	0,20	0,13	1,51	0,14
MOKTLO	-0,26	-0,12	0,17	-0,69	0,49

R= ,77	R^2= ,59	F(18,41)=3,22	p<,01

For this research, the Pearson correlation coefficients of applied motor variables were calculated for judokas respondents and specific situation-motor variable Yoko tomoe nage and are presented in Table 2.

The analysis of relations between the applied variables can lead to the general conclusion that a slight correlation is noticed between the predictor variables and criterion in relations between: Yoko tomoe nage (SMYTN) and Hand Tapping for 10 seconds (MTAPR10), Yoko tomoe nage (SMYTN) and Shoulder flex with bat (MISP), Yoko tomoe nage (SMYTN) and Raising body from a back lying position (MPTLG), Yoko tomoe nage (SMYTN) and Balance on inner hemisphere (MRPTV), Yoko tomoe nage (SMYTN) and Balance on external hemisphere (MRPTN), Yoko tomoe nage (SMYTN) and Agility in the air (MOVV) and Yoko tomoe nage (SMYTN) and Agility on the ground (MOKTLO).

Real significant correlation is determined between Yoko tomoe nage (SMYTN) and Standing long jump (MSDM), whereas high or very high correlation has not been registered.

The same table shows regressive analysis of the variable Yoko tomoe nage (SMYTN) as a criterion and motor system motor system of variables as predictors with respondents judokas. According to the obtained results it can be noted that the multiple correlation coefficient is 0,77, and the explained variability of the common variance is 59%. The correlation between the criterion variable and the system of applied predictor variables is statistically important at the level of p=0,01. Significant coefficient of the partial regression at the level of p=0,01 has been established for the variable Standing long jump

(MSDM) 0,01. Significant coefficients of partial regression at the level of p=0,05 have been established for the variables: Shoulder flex with bat (MISP) 0,02 and Throwing a medicine ball forward in a supine position (MFMLGN) 0,03.

Similar research was conducted for the paper of Mickoski, G., Kostovski, Z. (2013). The same system of predictor motor variables was used in that research. The regressive analysis of the obtained results also shows statistically significant impact of predictor system of motor variables on specific situation-motor variable uchimata, but partial participation in that research can be noted in four predictor variables which do not coincide with the variables which have partial impact on this research.

Conclusions

Based on the obtained results from the research conducted on 60 athletes – judokas aiming to determine the impact of criterion system of motor variables on specific situation-motor variable yoko tomoe nage, the following can be concluded:

1. High and statistically significant prediction is determined between the predictor set of motor variable and specific situation-motor variable yoko tomoe nage.
2. Partial impact on prediction of criterion variable yoko tomoe nage is determined among the representatives for assessment of: shoulder flex, explosive strength of lower limbs and explosive strength of upper limbs.

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DIFFERENCES IN SPIROMETRIC PARAMETERS BETWEEN TAEKWONDO COMPETITORS

UDC:796.856.093.1(497.5)
(Original scientific paper)

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Abstract

The basic aim of this research was to determine the differences in spirometric parameters between Croatian taekwondo competitors, medal winners at the state, European and World championships, and those competitors who did not win a medal at the mentioned competitions. The research was conducted on 54 (32 female, 22 male) Croatian taekwondo competitors. Besides the basic morphological measures, chronological age and training experience, the forced vital capacity (FVC) was measured, as well as forced expiratory volume in the first second (FEV1), Tiffeneau index (FEV1/FVC), medium part of the expiratory curve (FEF25-75) and forced expiratory flows at 50 % FVC (FEF50) and 25% FVC (FEF25).The differences between the groups of examinees were determined using the independent samples t-test. Statistically significant differences in spirometric parameters were obtained in the taekwondo competitors subsamples, and the differences were strongly emphasized in male competitors. The training process strengthens and causes the hypertrophy of the breathing muscles, as well as the increased conductivity of the airways, i.e., the increased ventilation function of the lungs. The mentioned differences are related to the growth of the total organism. As the size of the body increases, its need for oxygen increases, manifested by the increase of the size and the functions of the lungs. Since the medal winners were older, taller, heavier and had significantly longer training experience, the obtained results were expected.

Keywords: *function of the lungs, men, women, taekwondo, Croatia*

Introduction

Taekwondo is a polystructural acyclic sport dominated by fast techniques of kicks of the legs into the body and head of the opponent, while the hand kicks are allowed only towards the head of the opponent. The movements are performed in all three planes (Vučić, Čular, Milić, 2014).

According to the domination criteria of the energetic processes, taekwondo belongs to the group of high intensity anaerobic sports, characterized by fast and short actions. From the aerobic aspect, special energetic demands are set before the competitors by the need of participating in 4 or 5, and sometimes even more fights in one day of competition, with the aim of winning the gold medal (Čular, Krstulović, Tomljanović, 2011).

Aerobic abilities are the key to fast recovery between the rounds and matches at competitions. The high aerobic capacity positively influences faster recovery during and after the training, i.e., competition. Regarding the different energetic needs, the training process is conceived with the aim of developing all the energetic systems.

Research and studies related to taekwondo mostly cover the area of injuries, while the area of lung ventilation and functional diagnostics is barely covered. From the scientific point of view, the training of taekwondo athlete represents a great challenge to trainers, since taekwondo is, from the kinesiologic point of view, still a relatively unexplored area. In lack of relevant scientific research and cognitions, while planning and conducting training processes coaches still greatly depend on their own experience and traditional, unsubstantiated methods of preparing the competitors for the competition.

Based on the cited facts, the basic aim of this research was to determine the existence of differences in spirometric parameters between Croatian taekwondo competitors, winners of medals at state, European and World championships and those competitors who did not win a medal at the mentioned competitions.

Material and methods

The research was conducted on 54 Croatian taekwondo competitors. From the total number of examinees, 32 were women, and 22 men. Additionally, the examinees were divided into two groups: winners of medals at state, European and World championships and those competitors who did not win a medal at the mentioned competitions.

Except for the body height, body mass, chronological age and training experience, the following spirometric parameters were measured: forced vital capacity (FVC), forced expiratory volume in the first second (FEV1), Tiffeneau index (FEV1/FVC), medium part of the expiratory curve (FEF25-75) and forced expiratory flows at 50 % FVC (FEF50) and 25% FVC (FEF25).

The dynamic spirometric examination was conducted in concordance with the recommendations of the American Thoracic Society (ATS, 1994), using the portable spirometer – microQuark PC Based Spirometer (Cosmed, Rome, Italy). The examinees sat with their nose clogged, and they performed three forced expiratory manoeuvres, as recommended by American Thoracic Society-ATS and European Respiratory Society-ERS.

The best of the three repeated forced expiratory measurements was used for the analysis. The results were expressed in relative values (percentage) in relation to the predicted values (Miller et al., 2005).

The data processing methods included the calculation of basic descriptive indicators: arithmetic mean (M), standard deviation (SD), Minimum (Min) and Maximum result (Max). Distribution normality was tested by the KS-test. The stability of the differences between the competitors who won the medals and those who did not was determined using the t-test for independent samples, and the data was processed by *Statistica Ver. 12.00* computer programme.

Results

Table 1 shows basic anthropological indicators of the examinees. It is obvious that there was a significant difference in all the measured parameters between the examinees who won the medal and those who did not win the medal at the competitions.

Table 1 Basic anthropological indicators of female competitors (N=32)

	Medallists (N = 10)				No medal (N = 22)			
Variables	M	Min	Max	SD	M	Min	Max	SD
Age (years)	15.26	12.94	19.10	1.98	11.53	10.08	13.75	0.85
Body weight (kg)	52.80	43.00	64.00	6.03	41.32	29.00	66.00	9.61
Body height (cm)	169.50	160.00	181.00	7.06	151.05	135.00	175.00	10.42
Experience (years)	6.60	3.00	10.00	2.12	2.91	2.00	5.00	1.02

Legend: M – mean; MIN – minimum result; MAX – maximum result; SD – standard deviation

Table 2 shows basic anthropological indicators of male competitors (N=22)

	Medallists (N = 9)				No medal (N = 13)			
Variables	M	Min	Max	SD	M	Min	Max	SD
Age (years)	16.40	14.75	21.59	2.12	10.92	9.85	12.43	0.78
Body weight (kg)	62.00	49.00	84.00	10.05	37.85	28.00	55.00	6.79
Body height (cm)	176.00	167.00	186.00	5.85	147.15	135.00	162.00	7.83
Experience (years)	7.33	4.00	10.00	2.06	2.77	2.00	5.00	1.01

Legend: M – mean; MIN – minimum result; MAX – maximum result; SD – standard deviation

Inspection of Table 3 shows that none of the variables exceeded the critical value of the K-S test and we can claim that they did not significantly deviate from normal distribution. Also, a very large span of the spirometric parameters results is noticed, which varies from the lower referent interval with mild ventilation obstructive difficulties, up to the above average values.

Table 3 Spirometric parameters of female medal winners (N=10)

Variables	M	Min	Max	SD	maxD	K-S p
FVC (%)	95.98	83.20	110.70	8.20	0.14	p > .20
FEV1 (%)	102.95	76.20	121.20	10.32	0.14	p > .20
FEV1/FVC (%)	105.96	91.30	113.30	6.01	0.17	p > .20
FEF25-75 (%)	112.95	81.10	157.60	22.50	0.11	p > .20
FEF50 (%)	105.09	72.40	151.20	22.89	0.09	p > .20
FEF25 (%)	142.09	79.60	187.40	30.77	0.14	p > .20

Legend: M – mean; MIN – minimum result; MAX – maximum result; SD – standard deviation; max D – coefficient of the Kolmogorov-Smirnov test; K-S p - the level of significance of the K-S test coefficient

Table 4 shows that all the variables had normal distribution. The minimum values of spirometric parameters show mild restrictive difficulties and medium serious obstructive ventilation difficulties. The observed maximum values were above average.

Table 4 Spirometric parameters of female competitors without the medal (N=22)

Variables	M	Min	Max	SD	maxD	K-S p
FVC (%)	91.19	71.50	120.20	13.16	0.23	p > .20
FEV1 (%)	99.32	85.10	130.90	14.19	0.23	p > .20
FEV1/FVC (%)	106.29	95.70	112.10	5.30	0.23	p > .20
FEF25-75 (%)	110.94	70.10	152.90	26.75	0.19	p > .20
FEF50 (%)	107.30	66.30	147.20	26.33	0.21	p > .20
FEF25 (%)	109.55	61.80	158.90	29.25	0.13	p > .20

Legend: M – mean; MIN – minimum result; MAX – maximum result; SD – standard deviation; max D – coefficient of the Kolmogorov-Smirnov test; K-S p - the level of significance of the K-S test coefficient

Table 5 shows descriptive indicators of spirometric parameters of male medallists. It is obvious that all the measured variables had the distribution that did not significantly deviate from the normal one. The minimum values of spirometric parameters are on the lower referent limit, while the maximum values are above average.

Table 5 Spirometric parameters of male medallists (N=9)

Variables	M	Min	Max	SD	maxD	K-S p
FVC (%)	98.72	80.80	115.10	11.10	0.19	p > .20
FEV1 (%)	110.81	82.40	127.30	13.65	0.18	p > .20
FEV1/FVC (%)	112.17	101.90	117.90	4.55	0.13	p > .20
FEF25-75 (%)	122.64	80.30	144.80	18.37	0.15	p > .20
FEF50 (%)	121.48	82.90	148.30	18.93	0.17	p > .20
FEF25 (%)	119.23	62.10	156.50	24.23	0.21	p > .20

Legend: M – mean; MIN – minimum result; MAX – maximum result; SD – standard deviation; max D – coefficient of the Kolmogorov-Smirnov test; K-S p - the level of significance of the K-S test coefficient

Table 6 shows that all the used variables did not deviate significantly from normal distribution. The minimum values show restrictive and mild obstructive ventilation difficulties, while the maximum values are somewhat above the average of the norm value.

Table 6 Spirometric parameters of male competitors without the medal (N=13)

Variables	M	Min	Max	SD	maxD	K-S p
FVC (%)	90.89	67.90	102.80	11.64	0.26	p > .20
FEV1 (%)	93.69	79.30	99.40	6.66	0.23	p > .20
FEV1/FVC (%)	105.86	96.40	118.40	9.31	0.30	p > .20
FEF25-75 (%)	96.02	78.10	113.70	11.13	0.14	p > .20
FEF50 (%)	94.94	74.90	116.30	13.60	0.11	p > .20
FEF25 (%)	93.93	76.20	113.70	13.33	0.15	p > .20

Legend: M – mean; MIN – minimum result; MAX – maximum result; SD – standard deviation; max D – coefficient of the Kolmogorov-Smirnov test; K-S p - the level of significance of the K-S test coefficient

Table 7 shows the differences in spirometric parameters (determined by independent samples t-test) between Croatian female medallists and those without medals at state, European and World championships. The medal winners on average had higher values than the competitors without the medals. These differences were statistically significant in the FEF25 variable.

Table 7 Differences of spirometric parameters of female competitors

	Medallists (N = 10)		No medal (N = 22)		
	M	SD	M	SD	P
FVC (%)	95.98	8.20	91.19	13.16	0.217
FEV1 (%)	102.95	10.32	99.32	14.19	0.449
FEV1/FVC (%)	105.96	6.01	106.29	5.30	0.889
FEF25-75 (%)	112.95	22.50	110.94	26.75	0.826
FEF50 (%)	105.09	22.89	107.30	26.33	0.810
FEF25 (%)	142.09	30.77	109.55	29.25	0.009

Legend: M – mean; SD – standard deviation; p – independent samples t-test significance level

Table 8 shows that there were statistically significant differences between Croatian medallists and those who did not win a medal in 4 to 6 measured spirometric parameters. The medallists achieved significantly higher values in FEV1, FEF25-75, FEF50 and FEF25 parameters.

Table 8 Differences of spirometric parameters of male competitors

	Medallists (N = 9)		No medal (N = 13)		
	M	SD	M	SD	P
FVC (%)	98.72	11.10	90.89	11.64	0.126
FEV1 (%)	110.81	13.65	93.69	6.66	0.004
FEV1/FVC (%)	112.17	4.55	105.86	9.31	0.054
FEF25-75 (%)	122.64	18.37	96.02	11.13	0.001
FEF50 (%)	121.48	18.93	94.94	13.60	0.002
FEF25 (%)	119.23	24.23	93.93	13.33	0.010

Legend: M – mean; SD – standard deviation; p – significance level of the independent samples t-test

Discussion

Regarding the ± 20% of the accepted value as the acceptable level of normal values, we can conclude that the competitors of both genders had regular spirometic results. However, observing the minimum result values of both groups, we can notice serious difficulties of restrictive, obstructive and combined type in some individuals.

The obtained results of the morphological measures in female competitors in this research are congruent with previous findings (Marković, Mišigoj-Durakovićand Trninić, 2005; Čular, Erceg, Gabrilo., 2009). In both studies the female medallists were taller and heavier, compared to competitors without the medal.

Also, the anthropometry indicators results in male medallists are congruent with the results of previous studies (Čular et al., 2011; Čular et al., 2013). The medallists were taller and heavier, in relation to other competitors.

Observing the results of spirometric parameters in women, the results are somewhat unexpected. Although the medal winners were on average better in all the measured parameters, statistically significant difference was noticed only in FEF25 parameter.

The obtained results of spirometric parameter differences in male examinees were expected, the medallists were statistically significantly better in almost all measured parameters, which is congruent with the results of previous research (Čular et al., 2009; Erceg, Grgantov, Rađa, Milić, 2013).

The lung volume of athletes depends on the size of the body and it changes approximately in the same way as the height, until the age of 25. The mentioned changes are mostly expressed through widening of the existing alveoli and airways. Still, the influence of training on the respiratory system is significantly important. The exercises that demand high minute breathing volume encourage the growth and development of thorax in taekwondo competitors and the thorax becomes wider, longer and has more capacity. The so-called “sports lungs” develop a larger thorax, with larger air volume, and larger blood volume as well, and greater surface of lung alveoli. Further on, the training strengthens and causes the hypertrophy of the breathing muscles, as well as more economic breathing with lower frequency. In healthy people, the physical strain causes the increase of airways conductivity, i.e., the increase of the ventilation lung function. This effect of physical strain is based on the increase of the number of functionally active small airways and the dilatation of the bronchi and the bronchioles, and is probably the result of the decrease of the sympathicus tone. The conduct of taekwondo training during a prolonged period of time significantly improves the oxygen transport and usage system. The listed changes are related to growth of the total body. As the size of the body increases, its need for the oxygen increases as well, and this is manifested in the augmentation of lung size and function. Since the male medallists were older, taller, heavier and had significantly longer training status, the obtained results were expected.

Although, regarding the morphological measures, chronological age and training status, the situation in women was similar, the expected statistically significant differences in the spirometric parameters were not obtained. This can be explained by the fact that this sample did not show significant difference in chronological age and training status, or height and weight.

Conclusions

The basic aim of this research was to determine the existence of significant differences in spirometric parameters between the Croatian taekwondo competitors, winners of medals at the state, European and World championships, and the competitors who did not win any medal at the mentioned championships.

The observed subsamples of taekwondo competitors showed statistically significant differences in the spirometric parameters between the medal winners and other competitors. Those differences were more expressed in male competitors. It is well known that training strengthens and causes the hypertrophy of the breathing muscles, as well as the increase of the airways conductivity, i.e., the increase of the ventilation lung function. The medal winners in both subsamples of examinees had more experience in the training process, which explains the obtained differences.

The number of examinees should be increased in future research, and the smoking and passive smoking questionnaire should be conducted, as well as allergy and asthma status, because partial results indicate the potential existence of the mentioned lung diseases.

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PERCEIVED BARRIERS TO PHYSICAL ACTIVITY AMONG MACEDONIAN ADOLESCENTS

UDC: 796.012.6-053.6(497.7)
(Original scientific paper)

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Abstract

Many researches which were published in other countries identified certain benefits and barriers to physical activity among young people. But there is no data about the subject pertaining to Macedonian adolescents. This study tries to rectify this with a study of Macedonian adolescents. The research was realized on a sample of 847 adolescents of Macedonian nationality. Current exercise habits and perceived barriers to physical activity were assessed in the sample. Using a Likert Type scale, participants responded an instrument with 18 items representing barriers to physical activity. Adolescents who perceive less barriers have higher levels of physical activity. The most often reasons for their physical inactivity according to the respondents are: too many responsibilities at school, lack of time, too busy, parents who believe that learning is more important than exercising, lack of motivation and interest. The results should be taken into consideration when making strategies and educational programs to promote physical activity among young people.

***Key Words**: Perceived barriers, exercise, Macedonian adolescents.*

Introduction

The world is facing a new epidemic - an epidemic of inactivity. Man was created for movement, walking and physical activity. Historically, physical abilities were a condition of surviving and the survival of the individual, family and society. Today we have a strong tendency in the opposite direction. Most men and women in industrialized countries lead a sedentary life or only occasionally are active. The technical innovations facilitated the life of man, lifting the living standards on a higher level, providing a fairly free time, but on the other hand pushed the rhythm of life and work too fast, loaded nerves and took the man away from the very important life activities and from the physical engaging of his body.

The health consequences from this development are enormous. Physical inactivity increases the risk of many diseases, such as coronary heart disease, strokes, high blood pressure, diabetes, colon cancer, and possibly breast cancer, osteoporosis and further the connected fractures of the disease (Jones et al, 1998; Vuori, 1995). Furthermore, physical inactivity contributes to reduce physical and functional abilities among young people and middle aged and increases the risk of diminishing independence later. Physical inactivity is one of the leading causes of illness and reduction of quality of life, and with the increase of inactivity the risks are continuing to grow.

The period of adolescence is defined as the period between childhood and adulthood, characterized by dynamic physical development and significant changes in the cognitive, emotional and social development. In this period are formed the lasting habits for occupation with physical exercise (Andersen and Haraldsdottir 1993; Engström, 1986). Unfortunately, recent researches indicate that the level of physical activity constantly decreases during the adolescent years (Kann et al., 2000; Trost et al., 2002). Physical activity is a complex behavior which affects on many internal and external factors, such as socio-cultural, psychological, cognitive, physical and social environment surrounding the individual. (Dishman, 1994).

There are two cognitive variables that can determine the level of physical activity: perceived barriers and perceived benefits. Perceived benefits have positive influence, while perceived barriers have negative influence on the level of physical activity (Buckworth end Dishman 1999). These barriers have been classified in different ways. In recent years, examination of perceived physical activity barriers was

considered important to contribute to physical inactivity in samples of adolescents. Many studies which were completed in some countries evaluated perceived benefits and barriers to physical activity among young people (Brown, 2005; Cheng et al., 2003; Grubbs and Carter, 2002; Gyurcsik et al., 2004; Kenneth et al.,1999; 2005; Winters et al., 2003). But there are no existing about the subject in Macedonian adolescents. The purpose of this study was to analyze perceived barriers to physical activity in the Macedonian adolescents.

Methods

The research is realized on a sample of 847 respondents. The population from which the sample is drawn is defined as high school population from Skopje. The sample is defined as a group sample. The sample is divided into two sub-samples, 407 male respondents (students) and 440 female respondents (students). The age of the sample is defined as chronological age from 15 to 18 years (students from first to fourth year in high school).

For assessing in which stage of motivational readiness for change of the physical activity habits is the respondent, it is applied the instrument constructed by Marcus and colleagues (Marcus et. al., 1992), under the name of Stages of Exercise Behavior Change (SEBC) scale. The instrument is based on Trans-theoretical model and it classifies the respondents into five (5) categories according to whether they practice, how long they practice or intend to practice physical activity. Reliability of the instrument checked with test-retest method in the previous studies was ranging .78-.85 (K = .78-.85). The validity of the instrument was determined in comparison of direct measurements of physical activity with an accelerometer, compared with other tools for assessment of physical activity on the basis of maximum oxygen consumption VO2 and it was satisfying (Cardinal, 1995; Marcus, Simkin, 1994, 1997; Wyse 1995).

Perceived Barriers. Perceived barriers were measured using a 18-item scale which listed reasons why some people do not do physical activity. For example, 'I don't have enough time', 'I am not interested in physical activity' or 'I don't have the right equipment'. Adolescent were asked to say how true each reason was for them (very true/quite true/not very true/not at all true). A mean perceived barriers score, ranging from 1-5, was computed by averaging responses to the items (Sallis at. al. 1989; Cheng at. al. 2003; Kenneth at al. 2005).

Statistical analysis

The differences in the level of motivation readiness for change of the physical activity habits (classification according TTM) among respondents male and female is determined with Mann-Whitney U test. Gender differences in Perceived barriers scale were analyzed by one-way analysis of variance (ANOVA).

All the analyses were performed using the Statistical Package for Social Sciences software (SPSS, v. 20.0 for Windows; SPSS Inc., Chicago, IL, USA), and values of $p<0.05$were considered statistically significant.

Results

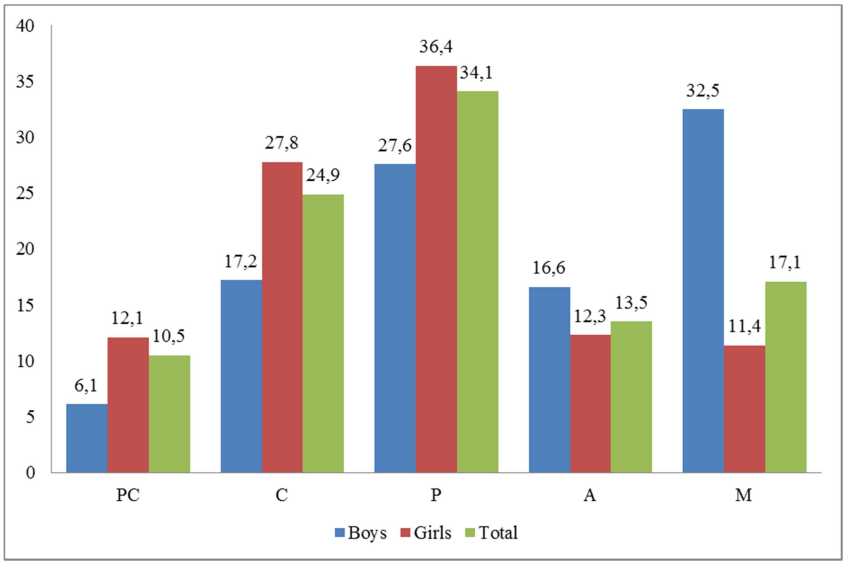
Graph 1 shows the classification of the respondents in five (5) categories according to their motivational readiness for change of the physical activity habits. From the review of the graph it can be seen that 10.5% of the respondents are in phase of contemplation (respondents who are not physically active and do not think about the need for physical activity), 24.9% of respondents are in phase of consideration (respondents who are not physically active but think about the need for physical activity), 34.1% of respondents who are in the phase of preparedness (respondents who are occasionally physically active or immediately ready to start regular physical activity), 13.5% of respondents who are in the phase of action (respondents who are physically active for less than 6 months), 17.1% of respondents who are in the phase of maintenance (respondents who are physically active for more than 6 months).

In order to determine whether there are differences in the level of the motivational readiness for habits change for physical activity (classification according TTM) among students it is applied the Mann-Whitney U test.

On the basis of the obtained results (Table 1) it can be seen that there are statistically significant differences in the level of the motivational readiness for change of physical activity habits among male

and female respondents . The average rank value indicates that male respondents have higher level of the physical activity (most of the students have regular physical activity), unlike the female respondents.

Table 2 shows the results of the applied univariant analysis of variance by which are determined intergroup differences in items of the scale for assessing perceived barriers. From the review of the table it can be seen that statistically significant univariant intergroup differences are determined in most items of the scale for assessing perceived barriers. The values of the arithmetic means and the level of statistical significance may be noted that male respondents show lower values in most items of the scale for assessing perceived barriers. Statistically significant differences were not determined in the items "Exercise is hard and tiresome" and "My parents, who believe that learning is more important than exercise."



Graph 1.*Classification of the respondents into five (5) categories according to their motivational readiness for change of physical activity habits*

Table 2. Exercise barriers items.

	Total		Boys		Girls		F	Sig.
	Mean	SD	Mean	SD	Mean	SD		
Lack of motivation and interest in physical activity	2,61	1,16	2,39	1,16	2,69	1,15	8,20	**,00**
Lack of energy	2,59	1,05	2,33	1,08	2,69	1,02	14,92	**,00**
I am not a sports type	2,21	1,34	1,73	1,15	2,39	1,36	29,70	**,00**
I have no company with whom to practice	2,25	1,17	2,01	1,14	2,33	1,17	9,04	**,00**
Too many responsibilities at school	3,20	1,29	2,74	1,37	3,38	1,22	29,90	**,00**
I do not enjoy doing exercise and sport	1,81	1,11	1,52	0,97	1,92	1,15	14,92	**,00**
I know I will not succeed in the workout, that is why I do not start	1,59	0,99	1,40	0,79	1,66	1,05	8,02	**,01**
Lack of knowledge of what and how to practice	1,75	1,01	1,59	0,91	1,80	1,04	5,35	**,02**
Exercising is hard and tiresome	2,03	1,09	1,94	1,11	2,07	1,09	1,73	,19
Lack of skills and abilities	1,86	0,99	1,71	1,01	1,92	0,98	5,26	**,02**
Physical activity is boring	1,59	0,93	1,43	0,84	1,64	0,95	6,10	**,01**
Lack of sports equipment	2,02	1,18	1,73	1,01	2,12	1,22	13,53	**,00**
My friends do not want to practice	2,20	1,15	1,81	0,95	2,34	1,19	26,06	**,00**
Too often I am tired to workout	2,53	1,21	2,14	1,12	2,68	1,20	25,60	**,00**
Lack of suitable place where I can practice	2,27	1,18	2,02	1,15	2,36	1,18	9,73	**,00**
My parents who believe that studying is more important than exercising	2,26	1,31	2,42	1,33	2,20	1,30	3,59	,06
Too often I am busy	3,03	1,22	2,66	1,26	3,17	1,18	21,21	**,00**
Health problems	2,91	1,23	2,55	1,26	3,05	1,19	19,74	**,00**
Internal barriers	2,09	0,74	1,84	0,69	2,18	0,74	26,16	**,00**
External barriers	2,43	0,71	2,17	0,69	2,52	0,69	30,54	**,00**

Table 2. *Differences of the level of physical activity (classification TTM) among students*

Grupa	Mean Rank	Mann-Whitney U	Wilcoxon W	Z	Q
Male	388,57	31967,00	128547,00	-6,29	**0,00**
Female	292,82				

Discussion

The research results provide preliminary information for the motivational readiness for the physical activity habits change and perceived barriers among adolescents of Macedonian nationality. Analyzing the received information and comparing them with similar international researches, it can be concluded that 30.6% of the respodents have regular physical activity (respondents in the action and maintenance phase), 33.7% of the respondents exercise periodically (respondents in the readiness phase) and 34.7% of the respondents do not exercise in their free time (respondents in contemplation and consideration phase). From the information analysis it can be seen that a large percentage (70%) of young people at the age of 15 to 18 years do not have regular (recommended) physical activity, and this is especially expressed among women. In a research of Kearny and the collabolators (Kearny at al. 1999), who researched on respondents at the age of 15 to 24 years in 15 members states of the European Union, found that around 30% of young people from EU countries do not have physical activity, 22% of the respondents have periodical physical activity and 46% of the respondents have regular physical activity (respondents in the action and maintenace phase). Ilse and the collaborators (De Bourdeaudhuij et al. 2005), researched the physical activity among adolescents in Belgium and found that 28% of the respondents do not have physical activity (respondents in the contemplation and consideration phase), 21% of the respondents have periodical physical activity and 51% of the adolescents in Belgium have regular physical activity (respondents in the action and maintenace phase). Gustavo and Maria (Gustavo de Sá e Souza, Maria de Fátima da Silva Duarte, 2005), researched the physical action among Brazilian adolescents at the age of 14 to 19 years, respondents extracted from 29 private schools. The researched results showed that 26.2% of the respondents have no physical activity, 35.4% of the respondents have periodical physical activity and 38.3% of the respondents have regular physical activity. Nigg and Courneya (Nigg and Courneya, 1998) researched the physical activity among Canadian adolescents at the age of 13 to 19 years. The researched results showed that 6.2% of the respondents were in the contemplation and consideration phase, 28.7% of the respondents were in the readiness phase and 65% of the respondents had regular physical activity (respondents in the action and maintenace phase). Thrope and the collabolators (Thrope at al., 2006), have researched the level of the physical activity among Australian adolescents at the age of 11 to 18 years. The researched results showed that 30% of the respondents have no physical activity, 23% of the respondents were in the readiness phase and 46% of the respondents have regular physical activity (respondents in the action and maintenace phase). From the comparative analysis it can be seen that our young people have the lowest levels of physical activity (the lowest percentage of our young people have recommended physical activity) compared to the young people in other countries in which similar researches were realized.

The transition from 15 to 16 years among students of both genders have a major reduction in physical activity, which in female students continues to decrease slightly up to 18 years, while among students after 16 years it slightly increases. This is confirmed in research of Salis and the collabolators, Brodersen and the collabolators (Sallis at al., 2000; Brodersen et al., 2007), and as a reason they state the biological basis and possibly the mechanism of dopamine system that regulates the motion motive.

The degree of perceived barriers is in negative relation with physical activty among students of both genders. This is confirmed in researches of Stucky, DiLorenzo, Tappe, Duda, Menges, Zakarian (Stucky-Ropp and DiLorenzo 1993; Tappe, Duda, Menges-Ehrnwald 1990; Zakarian et al. 1994). The dominant barrier among students of both genders is the lack of time which is confirmed in many previous researches (Allison et al. 1999; Grubbs, et al. 2002;Gyurcsik et al., 2004).

As the 5 most common reasons for physical inactivity, female respondents indicate: too many responsiobilities at school, lack of time, too busy, lack of energy and lack of motivation and interest. Analyzing the individual subscales may be noted that the dominant barriers among female students are lack of time (external barrier), lack of energy and lack of social support. Male respondetns as 5 most

common reasons of physical inactivity emphasize: too many responsibilities at school, lack of time, too busy, parents who belive that studying is more important than exercise, lack of motivation and interest. Analyzing the indcividual subscales it can be seen that the dominant barriers amog male respondents are lack of time (external barrier), lack of energy and lack of social support. Among respondents who are in the contemplation phase dominate more internal barriers such as ”I’m not sports type”, ”I’m tired too often”, ”lack of motivation and interest”, while respondents who are in maintenace phase dominate more external barriers such as lack of time and parents support.

Considring the obtained results, current researches and expert literature analysis can give some recommendations in which directions should move the interventions, strategies and educational programs designed to increase physical activity among young people. As the most common barrier that respondents emphasize and can influence the physical activity is lack of time and energy. If the lack of time is a barrier, the respondents should be explained to divide the physical activity into several sessions of 10 minutes (example: respondent can exercise 10 minutes before going to school, 10 minutes after school and 10 minutes before bedtime). Also, the respondent should learn the skills for effective time management. Respondent may take the time that spends on the computer or watching TV instead or going to the coffee with friends, can go to a fitness center or gym and also have good time. Although it should be explained to the individual that exactly the physical activty will help to increase energy levels.

Problems at school, too many responsibilities at school (periods when there is too much for studying, writing, etc.) can be a factor that can lead to discontinuity in physical activity. Respondent should be educated when there is a lot to learn, to take some time for physical activity that will refresh and help later easily and successfully to study the material and do better the work tasks. Stressful life may contribute the decrease of physical activity and therefore it is very important to educate the students that physical activity is particularly important during stressful situations because it can help in relieving the stress and increase energy levels.

The researched results indicate that educational program and strategies should be aimed at increasing the selfefficiency, confidence in their abilities, increase the level of perceived benefits to physical activity, decrease the barriers, increase social support from loved ones in the enviroment (parents and peers) as well as to offer the young people the activities that will choose and enjoy themselves. It is also necessary to provide safe and attractive places, green spaces and sports facilities where they can play sports and recreate. Emphasis on educational programs to promote the physical activity should be put in early adolecence, before 15 years.

There are more ways (channels) that can carry out the strategies and educational programs to promote physical activity among young people. It can be carried out by the method „face to face” (direct education), the use of printed material (manuals, brochures, flyers, billboards, etc.), multimedia material (CD or DVD), the use of means of mass media (TV, radio, newspapers), and the use of internet through which you can easily reach out to young people, because a large percentage of them use it.

They can use different approaches: individual work, group work, workshops, conferences and so on. Chief promoter of the educational programs and strategies should be the school, but also it should include more governmental organizations, family and local government and state wide media campaign. Changes in the school should be directed to changing the curriculum which should include contents for physical activity and its significance, including new forms of physical activity in the curriculum, improvment of material base (buildings, exercise equipment, etc.).

Although the trans-theoretical model has been addressed with some criticism, however, it represents one of the few most important attempts for operationalization of various strategies to change physical activity and other health behaviors. Those results indicate that the trans-theoretical model is applicable to different types of behavior and different populations that suggests the possibility of a high degree of generalization.

Conclusion

Most items of the scale for assessing the perceived barriers more or less affect the level of motivational readiness for physical activity habits change among adolescents. Adolescents who perceived less barriers have higher levels of physical activity. The most common reason for physical inactivity adolescents emphasize: too many responsibilities at school, lack of time, too busy, parents who believe that studying is more important than exercise, lack of motivation and interest.

The researched results indicate that the trans-theoretical model that unites many theories is applicable and can be used in prediction, control and behavior change (change of physical activity) among high school population. The results should be taken into account when developing strategies and educational programs to promote physical activity among young people.

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CORRELATION OF MOTOR ABILITIES AND MOTOR SKILLS IN SEVEN-YEAR-OLDS ATTENDING JUDO SCHOOL

UDC:796.853.23.012-1-057-874
(Original scientific paper)

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Abstract

The main objective of this study was to determine the correlation of motor abilities and motor skills in seven-year olds attending judo school (n=41). Based on the main aim, two sub-aims were derived: to determine the metric characteristics of the five judo skills analysed, and to determine partial and global correlations of motor abilities and motor skills in young judoka. We used twelve motor tests to assess motor abilities and five tests to assess motor skills. The best partial correlation with motor abilities was exhibited by the o sotogari - major outer reaping throw. Canonical correlation analysis showed significant correlation of the overall dimension of motor abilities with the selected judo motor skills (p=0,025). Furthermore, it can be assumed that the frequent repetition of o sotogari and ushiro-ukemi in training of young judoka, could positively influence the development of specific motor skills necessary for success in judo fight, especially for developing explosive strength of arm and legs. Based on the results it can be concluded that for the successful implementation of techniques or elements in judo, young judokas need to have all equally highly developed motor skills. This fact should be taken into consideration in the selection and orientation of young judoka.

Key Words: *Motor abilities, motor skills, judo, selection*

Introduction

Judo is one of the most popular combat sports (Brouse and Matsumoto, 1996). Undoubtedly, this can be attributed to judo becoming an Olympic sport in 1964. This dynamic combat sport has taken over almost all world countries today, and in many of them it is one of the most popular individual sports. It is also seen as an art form. According to its structure of movement, judo falls into the category of polistructural acyclic sports in which acyclic movements are dominant, with a binary variable as a final result, i.e. one judoka winning and the other one losing (Krstulović, 2010, according to Kuleš, 1980). Judo performances are complex to explain, primarily because they are determined by different technical, tactical and physiological parameters (Detanico et al., 2012). As a system of psychophysical development, judo has a primary goal of getting a person to a state of complete emotional, psychological and physical maturity and stability through its methods and exercises (Dragić, 1985). This ultimate goal of judo is achieved through a series of immediate goals imposed on judoka during exercise. The first immediate goal of judo is to overpower opponent's brute strength by yielding, speed and skill of movement. Relations between perceptive and motor skills were analysed by (Calmet and Ahmaidi, 2004). Putting the opponent into a position of insecurity requires mastering of several throws. Authors Perrin et al. (2002) compared how completely different motor activities (judo and dance) develop sensory-motor adaptation in the area of balance control. In their paper hypotheses were set stating that training enables athletes to acquire new abilities of balance control which would be differentiated according to the discipline in which a judoka is involved. Postural skills of highly ranked judoka, professional dancers and the control group were analysed to determine whether the mentioned activities improve postural control. Better results with eyes open were recorded in judoka and dancers in comparison to the control group, which shows a positive effect of training on sensory-motor adjustments. However, with eyes closed, judoka achieved significantly better results. Motor abilities and anthropometric characteristics considerably discriminate successful judoka from less successful ones, so they must be considered an important selection criterion in judo. The results of motor-functional tests should be compared to model

values of elite (or the best in the country) judoka of the same age, and based on these pieces of information, the future training process should be programmed. By applying a smaller number of tests, it would be hard to evaluate the motor-functional potential of judoka (Lidor et al., 2005). It is known that there is a causal relationship between motor skills and motor abilities. In judo, it is important to investigate what specific skills and their practice would lead to the development of motor abilities, and what motor abilities are key to the performance of specific motor judo skills. According to Perin et al. (2002), repetition of kinesiological judo operators will lead to the development of specific development of balance, more precisely of sensory-postural control (with eyes closed) which is crucial for competitive success in judo. The investigation of influence of fully determined judo motor skills on the development of abilities relevant for success in a judo fight leads us to the information on what operators (in the wide spectre of judo techniques) should be repeated with higher frequency because they would lead to the development of specific urgent abilities relevant for success in judo. The main aim of this study was to determine the correlation between motor abilities and motor skills in judo among seven-year-olds attending judo school. Based on the main aim, two sub-aims were derived: to determine the metric characteristics of the five judo skills analysed, and to determine partial and global correlations of motor abilities and motor skills in young judoka.

Material & methods

The *subject sample* included 41 male first grade students of elementary school (aged 7.2 years), who have practiced judo for 9 months. The only criterion for student selection was for them to be clinically healthy and free of aberrations, and not to be actively involved in any other extracurricular physical activity. It must be emphasized that during the 9 months all the boys followed the same programme, had the same coach, and participated in the minimum of 80% of training and regular PE classes.

The *variable sample* included 12 motor tests for assessing motor abilities and 5 tests for assessing motor skills in judo. The following tests were used: the obstacle course backwards test (MPOL) to assess global coordination; the lateral steps test (MKUS) to assess agility; the shoulder flex (MISKR) and seated straddle stretch (MPRR) tests to assess flexibility; the arm plate tapping (MTAR) and foot tapping (MTAN) tests to assess movement frequency; the standing long jump (MSDM), throwing a ball (MBLD) and 20 m sprint from standing position (M20V) tests to assess explosive power; the sit-ups (MDTS) test to assess dynamic strength; the bent-arm hang (MVIS) test to assess isometric strength; and finally, the 3 minute run (MT3M) test to assess aerobic endurance.

For the evaluation of motor skills, the subjects had to perform the following judo elements: forward roll *zempo-kaitenukemi*(ZKAIT) – right, side fall *yoko-ukemi*(YOUKE) – right, backward roll *ushiro-ukemi*(USUKE), major outer reaping throw *o sotogari*(OSTG) –right, floating hip throw *ukigoshi*(UKGOS) – right. In the falling techniques, the following was evaluated: amortization by one or two hands during falling, angle between the arm and the body during falling performance, body position during falling performance, the size of contact surface with the mat. In the throwing techniques, the following was evaluated: breaking balance*ukea* (*kuzushi*), fitting the body into proper position for throwing (*tsukuri*), control of contact during lifting and throwing *uke*, stability of *tori*, continuity of performance and throwing amplitude (*kake*). The techniques were evaluated by three judges (black belt holders with great field experience). Each subject repeated all falling techniques three times (frontal, side and backwards). The subjects also performed throwing techniques three times, each time with a different partner of approximately the same height and weight. The evaluators assigned a mark from 1 to 10 for each technique a subject performed.

Basic statistical parameters (mean (Mean), minimum (Min), maximum (Max), coefficient of variation (CV%), standard deviation (SD), coefficient of asymmetry (Skewness), coefficient of flatness (Kurtosis) and Kolmogorov-Smirnov test (KS)) of all variables for the overall sample of boys were analysed. To determine the metric characteristics of the analysed motor skills, the following analyses were applied: coefficient of asymmetry (Skewness), coefficient of flatness (Kurtosis) and Kolmogorov-Smirnov test (KS) were calculated to assess the sensitivity of motor skills; Cronbach's alpha (α), inter-item correlation (IIr) and intercorrelation of judges' evaluations were calculated to assess judges' objectivity; the first principal axis of items in the evaluation space for each skill and the percentage of the explained variance were calculated to assess the homogeneity of the items in the evaluation measuring instrument. To determine the partial correlation between the variables of motor abilities and motor skills, linear correlation analysis was calculated. To determine the global correlation between the variables assessing

motor abilities and the variables assessing motor skills, canonical correlation analysis was calculated, with the following parameters: canonical coefficient of correlation (Can R), canonical coefficient of determination (Can Rsq) and the pertaining levels of significance (p). After the conducted measurements, the obtained data were entered into the Statistica for Windows Ver.10.0 programme.

Results and discussion

Basic statistical parameters of variables for assessing motor abilities are presented in Table 1: Basic statistical parameters of variables for assessing motor abilities and motor skills: mean (M), minimum (Min), maximum (Max), coefficient of variation (CV%), standard deviation (SD), coefficient of asymmetry (*Skewness*), coefficient of flatness (*Kurtosis*) and Kolmogorov-Smirnov test (KS). In most variables assessing motor abilities a relatively even range of results between minimum and maximum result can be noticed. By observing the relative variability (coefficient of variation), it can be noticed that the MVIS variable has the highest variability. The results of isometric strength among children are different and can be changed in a short period of time, which is characteristic for this age, exactly because of growth and development (Bompa, 2000). A smaller dispersion of results around the mean can be notices in the motor skills variables, in comparison to the variables assessing motor abilities. Such result is logical given that the variability of the results of the variables assessing motor skills is limited beforehand by marks from 1 to 10. By examining the values of coefficients of asymmetry (*Skewness*) in the table, it can be seen that the *backward roll* (USUKE) motor skill was the easiest for children to master, and the lowest mark for this skill was 4. This can be interpreted by the fact that the backward roll is the least demanding of all skills in terms of technical difficulty. It is clear that the values of coefficients of asymmetry (*Skewness*) were positive for each motor skill. The coefficient of variation (CV%) in the table shows a relatively similar dispersion of results. Lower dispersion can be seen in the USUKE variable, whereas is somewhat higher in the YOUKE variable. The Kolmogorov-Smirnov test for each measured variable confirmed normality of distribution of all the variables applied.

Table 1. *Basic statistical parameters of variables for assessing motor abilities and motor skills: mean (M), minimum (Min), maximum (Max), coefficient of variation (CV%), standard deviation (SD), coefficient of asymmetry (Skewness), coefficient of flatness (Kurtosis) and Kolmogorov-Smirnov test (KS).*

	Mean	***Minimum***	***Maximum***	***CV%***	***Std.Dev.***	***Skewness***	***Kurtosis***	***K-S***
MPRR	45.75	25.00	64.00	18.44	8.43	-0.34	0.04	>0.20
MISKR	49.92	35.00	72.00	18.79	9.37	0.97	0.27	>0.20
MPOL	15.67	9.87	22.25	21.58	3.38	0.44	-0.68	>0.20
MKUS	12.83	10.48	15.38	9.28	1.19	0.20	-0.70	>0.20
MSDM	133.57	96.66	164.33	11.76	15.70	-0.35	0.03	>0.20
MBLD	11.49	5.50	17.16	27.42	3.15	0.02	-0.79	>0.20
MTAR	20.45	15.33	25.33	11.13	2.27	-0.12	-0.43	>0.20
MTAN	29.81	22.66	35.00	8.76	2.61	-0.63	0.90	>0.20
MDTS	30.73	19.00	42.00	20.53	6.30	0.13	-0.95	>0.20
MVIS	23.38	4.97	53.77	58.96	13.78	0.56	-0.57	>0.20
MT3M	523.48	405.00	695.00	10.34	54.10	0.70	1.79	>0.20
M20V	4.50	4.00	5.21	5.93	0.26	0.34	0.25	>0.20
USUKE	7.57	4.00	9.00	18.03	1.36	-1.12	0.32	<0.10
YOUKE	5.33	1.33	9.00	42.23	2.25	-0.05	-1.24	>0.20
ZKAIT	5.89	1.67	9.33	33.25	1.96	-0.60	-0.32	>0.20
OSTG	5.80	1.67	9.00	29.93	1.74	-0.60	0.09	>0.20
UKGOS	5.80	1.00	9.00	37.87	2,20	-0.76	-0.36	>0.20

Table 2. *Values of coefficients of objectivity (Cronbach's alpha coefficientα and inter-item correlationII r)*

	A	***IIr***
USUKE	0.94	0.85
YOUKE	0.97	0.92
ZKAIT	0.95	0.88
OSTG	0.97	0.91
UKGOS	0.97	0.93

In Table 2 it can be seen that standard indicators of judges' objectivity (Cronbach's alpha coefficient and inter-item correlation) have high values and are a reflection of good compatibility of judges, i.e. synchronisation.

Table 3.*Intercorrelations of judges - evaluators (S)*

	USUKEM			***YOUKEM***			***ZKAIT***			***OSTG***			***UKGOS***		
	S1	**S2**	**S3**	**S1**	**S2**	**S3**	**S1**	**S2**	**S3**	**S1**	**S2**	**S3**	**S1**	**S2**	**S3**
S1	1.00			1.00			1.00			1.00			1.00		
S2	0.88	1.00		0.94	1.00		0.89	1.00		0.94	1.00		0.92	1.00	
S3	0.83	0.84	1.00	0.93	0.92	1.00	0.90	0.88	1.00	0.82	0.92	1.00	0.94	0.95	1.00

Correlations between judges' evaluations in all five skills are presented in Table 4. It is evident that the correlation is high, which is an indicator of independence of young judoka's performance from error in evaluation.

Table 4*. Structure of the first principal axis in the space of evaluator items*

	USUKE	***YOUKE***	***ZKAIT***	***OSTG***	***UKGOS***
S1	-0.95	-0.98	-0.97	-0.97	-0.97
S2	-0.96	-0.98	-0.96	-0.98	-0.98
S3	-0.94	-0.97	-0.96	-0.97	-0.99
Exp.Var.	2.70	2.86	2.78	2.83	2.87
Prp.Totl	0.90	0.95	0.93	0.94	0.96

Table 5. *The correlation matrix between the variables assessing motor abilities and the variables assessing motor skills in judo (p=0.05).*

	USUKEM	***YOUKEM***	***ZKAIT***	***OSTG***	***UKGOS***
MPRR	0.45	0.22	0.20	0.39	0.26
MISKR	-0.23	-0.29	-0.19	-0.32	-0.17
MPOL	-0.42	-0.29	-0.14	-0.29	-0.12
MKUS	-0.22	-0.27	-0.22	-0.30	-0.21
MSDM	0.58	0.33	0.37	0.42	0.23
MBLD	0.50	0.40	0.52	0.55	0.40
MTAR	0.20	0.23	0.36	0.34	0.39
MTAN	0.12	0.35	0.28	0.21	0.28
MDTS	0.34	0.44	0.32	0.41	0.43
MVIS	0.12	0.18	0.20	0.22	0.19
FT3M	0.32	0.26	0.03	0.18	0.16
M20V	-0.35	-0.36	-0.08	-0.28	-0.22

Latent dimensions in the variable space of evaluators, i.e. judges are presented in Table 4. It is clear that each item contributes to the common subject of measurement, thus every judge evaluates the same subject of measurement. It can be concluded that satisfactory homogeneity of items was achieved. It can

also be seen in the table that a high percentage of the total variance of the system of items for each factor was explained.

Linear correlation between the variables assessing motor abilities and the variables assessing motor skills in judo is presented in Table 5. In this paper, variables assessing judo motor skills play the role of criterion variables, i.e. referent values for assessing technical skills of young judoka, so they will be interpreted as such hereinafter. It can be seen in Table 5 that all statistically significant correlations between motor abilities and motor skills were positive. Such results were expected because a whole series of previous studies have confirmed positive correlation of motor abilities (especially coordination) on one hand and motor skills on the other (Miletić et al., 2004). It can be noticed that motor variables are mostly significantly correlated with all the applied judo motor skills. It can also be seen in Table 5 that the highest correlation was found between motor variables and the *o sotogari* (OSTG) throwing technique. It can be concluded from this that the throwing technique (OSTG) was best performed by the boys with all types of strength-power developed, who were coordinated, and in addition, flexible in lower extremities. Based on these results, it can be inferred that practically all motor abilities must be developed for quality realization of judo motor skills in seven-year-olds attending judo school. The best partial correlation to motor abilities was demonstrated by the *o sotogari* (OSTG) throwing technique.

***Table 6**. The results of canonical correlation analysis between the variables assessing motor abilities and motor skills (Root – structure of significant canonical root: Can R – canonical coefficient of correlation; Can Rsq coefficient of canonical determination; p – level of significance).*

	Root 1
MPRR	0.56
MISKR	-0.40
MPOL	-0.44
MKUS	-0.40
MSDM	0.71
MBLD	0.83
MTAR	0.49
MTAN	0.32
MDTS	0.59
MVIS	0.29
FT3M	0.29
M20V	-0.38
USUKE	0.83
YOUKE	0.66
ZKAIT	0.76
OSTG	0.87
UKGOS	0.72
CanR	0.75
CanRsq	0.58
P	0.025

The results of canonical correlation analysis that was calculated between the variables assessing motor abilities and motor skills are presented in Table 6. Significant correlation is noticed of the first two canonical roots with the coefficient of correlation of 0.75, which defines 58 % of the explained variance. The motor space was explained by high projections of all motor abilities variables. In the space of motor skills, all the variables were also prominent, with the *o sotogari* (OSTG) throwing variable particularly standing out. It can be inferred from these results that high values of all motor variables had a positive influence on realization of falling and throwing techniques, especially of the *o sotogari* throw. It can be noticed that the variables of shoulder flex (MISKR), obstacle course backwards (MPOL), steps lateral

(MKUS) and 20 m sprint from standing position (M20V) had negative projections on canonical roots. The reason for this is that lower value in these variables also means better result.

Conclusion

The aim of the conducted research was to determine the correlation of motor abilities and motor skills measured in seven-year-olds attending judo school. The subject sample included 41 boys aged 7 years, first grade students of elementary school who have attended judo school. The measurement included 12 motor tests and three judges evaluated five judo elements. The best partial correlation with motor abilities was exhibited by the *o sotogari* leg throwing technique. Canonical correlation analysis showed significant correlation of the overall dimension of motor abilities with the selected judo motor skills. Furthermore, it can be assumed that more frequent repetition of the major outer reaping throw *o sotogari* and the backward roll *ushiro-ukemi*in training young judoka could have a positive influence on the development of specific motor abilities crucial for success in a judo fight, especially for the development of explosive power of arms and legs. Based on the obtained results it can be inferred that for successful realization of techniques, i.e. elements in judo all motor abilities must be equally highly developed. This fact should be taken into consideration during the selection and orientation of young judoka.

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DIAGNOSIS AND CONTROL OF THE CONDITION OF THE BODY COMPOSITION OF THE MEMBERS OF THE SPECIAL POLICE UNITS IN REPUBLIC OF MACEDONIA

UDC:351.74:796.012.6(497.7)
(Original scientific paper)

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Abstract

The physical and body composition are important part of the common performance capability of the police officers in performing the police officer duty. Knowledge of the internal structure of the body is of crucial importance, since it can help a lot in improving the quality of performance of the work duties, and at the same time it can help to stop or reduce many degeneration processes that are result of the mutual influence of different endogenous and exogenous factors. Taking into consideration the importance of the information for possession of body composition of high quality, a research has been conducted with the aim to determine the situation of the body composition of the members of the special police units of the Republic of Macedonia. By application of the method of assessment of the body mass index (BMI-Body Mass Index), an evaluation of the body is carried out in which 160 respondents were included. The evaluation is conducted according to the normative (BMI) criterion and on the basis of it, the body fat in all body mass index categories was determined. The results from the statistical analysis which were carried out show that the respondents generally have adequate body composition but there are also individuals with inadequate or professionally unacceptable body composition.

Key Words: *police officer, BMI, body evaluation.*

Introduction

The physical and body composition are important part of the common performance capability of the police officers in performing the police officer duty. Taking into consideration the complex work duties and professional activities performed by the police every day, it is important to know and be informed on the condition of the body tissues and the skeleton. Knowing the internal structure of the body is of crucial importance, since it can help a lot in improving the quality of the performance of the work duties, and at the same time it can help to stop or reduce many degeneration processes that are result of the mutual influence of different endogenous and exogenous factors.

Considering the importance of the information we have about a body composition of high quality, there is a need of satisfying the professional needs of information we have on daily basis. Due to the nature of the police office profession it is necessary that the members of the special police units maintain constantly the body composition on high level, since it is the only way to perform the professional tasks successfully and freely.

As a result of the big dynamic and static stress (frequent exposure to stressful situations, work on shifts, skipping meals or having meals with low quality, social and professional pressure etc.) which is typical for the work of these police units, certain changes appear in the bodies of the police officers which are caused by this manner of work. In other words, the constant uncertainty which is result of the performance of the police officer duty causes negative changes in their bones, skeletal system, muscular and subcutaneous tissue. These alterations which appear in the bodies of the police officers result in weight loss, bone and joints deformation, emaciation, decrease of the skeletal muscle or increased fat tissue. (Todorovska, 1999).

To prevent this situation we need to observe, control and develop constantly the body (anthropometric) characteristics in direction to the professional needs of the police. For that reason, the

special police units during their professional career should work in order to mutually coordinate the personal and professional habits and needs.

The goal of this research is to evaluate and assess the body composition of the members of the special police units of the Republic of Macedonia by use of the method for BMI assessment (BMI-Body Mass Index) and to determine the normative standard (criterion) that will be used in relation to the anthropometric specific characteristics of the respective police.

Material & methods

Respondent sample

The research is performed on 160 respondents - members of the special police units of the Republic of Macedonia, out of which 80 respondents are members of the Rapid Deployment Unit (RDU) and 80 respondents are from the Mobile Unit for Fight against the Crime (ALFI). The age of the respondents is between 22 and 46, and the average is 34 years. During the selection of the subsamples we considered the fact that the selection should have been made in accordance with the principle of coincidence with the goal to provide higher level of accuracy of the results and to obtain more valid generalization of the results.

Variable samples

The variable samples in this research are composed of one derived (index) anthropometric variable which helped to estimate the body composition of the respondents. We talk about the Body Mass Index (BMI) which is derived on the basis on the mathematic formula of the measurements of the weight and height of the body BMI=Weight(kg)/ Height(m)² (Carrow, 1985). According to these calculations (BMI) is expressed in kg/m² and shows how many kilograms of body mass are there on a square body height.

Statistical elaboration of the data

In order to achieve the goal which was set, the data received from BMI were elaborated with descriptive statistical methods. Regarding this, first of all, the basic measures of central tendency and dispersal have been calculated, then, the normality of the results distribution have been established, and finally, with the use of frequency analysis, the results were grouped in classes. With the use of the sport and normative BMI criterion (Zaciorski, 1982), we observed that the respondents from both special units have fat tissue in all body mass index categories. For calculation of the above mentioned statistical operations, the software program SPSS Statistics 17 was used (Hair et al., 1998).

Results

The basic statistical parameters of the derived anthropometric variable (BMI) for both groups are given in tables 1 and 2. Observing the results in the tables we can see a big similarity in the calculated measures for central tendency and dispersion. According to the height of the average values X=27,04 and X=28,34 both groups belong to the overweight category or class I obesity. (BMI=25-29,9 kg/m²). The calculated variables show a big internal stability and small variations of the results regarding the average values, which show that the empirical results are not very different from the theoretical ones. The results from the test for normal distribution Kolmogorov and Smirnov (K-S) are affirmation of this finding, which means that the values which were received can be included in further statistical procedures.

Table 1. Basic descriptive parameters of BMI for the respondents from RDU

Variable	N	X	Min.	Max.	SD	KV%	Skewness	Kurtosis	K-S
BMI	80	27,04	20,00	33,25	2,89	10,68	0,10	1,05	0,17

Table2. Basic descriptive parameters of BMI for the respondents from ALFI

Variable	N	X	Min.	Max.	SD	KV%	Skewness	Kurtosis	K-S
BMI	80	28,34	19,33	34,79	2,85	10,05	-0,13	1,12	0,18

Tables 3 and 4 show the results of the frequency analysis for the two groups on which basis the distribution of BMI, in accordance with the sport and normative criterion, was performed. Based on the results in table 3 we can ascertain that 17 (21,25%) respondents are with normal weight, 56 (70,00%) respondents are overweight (38,25% based on muscle tissue 31,25% based on body fat) and 7 of the respondents or 8,75% are obese (class I obesity). The results in the table 4 show that only 1 respondent is underweight (1,25%), and in the category of respondents of normal weight there are 9 (12,50%) respondents, in the category of overweight respondents there are 52 (65,00%) respondents or (32,50% based on muscle tissue and 32,50% based on body fat) and in the category -obesity - class 1, there are 18 (22,50%) respondents.

Table 3.Distribution of BMI values for RDU respondents, according to the sport and normative criterion

Level of Obesity	Weight level	BMI values (kg/m²)	f	Cum (f)	%	Cum (%)
	Underweight	< 19,99				
0 level	Normal weight	20 - 24,99	17	17	21,25	21,25
I level	Overweight: - based on muscle tissue	25 - 27,85	31	48	38,75	60,00
	- based on body fat	27,86 - 29,99	25	73	31,25	91,25
I¹level	Obesity - Class 1	30 - 34,99	7	80	8,75	100,00
II²level	Obesity - Class 2	35 - 39,99				
III level	Obesity - Class 3	> 40				

Table 4.Distribution of BMI values for ALFI respondents, according to the sport and normative criterion

Level of Obesity	Weight level	BMI values (kg/m²)	f	Cum (f)	%	Cum (%)
	Underweight	< 19,99	1	1	1,25	1,25
0 level	Normal weight	20 - 24,99	9	10	12,50	13,75
I level	Overweight: - based on muscle tissue	25 - 27,85	26	36	32,50	46,25
	- based on body fat	27,86 - 29,99	26	62	32,50	78,25
I¹level	Obesity - Class 1	30 - 34,99	18	80	22,50	100,00
II²level	Obesity - Class 2	35 - 39,99				
III level	Obesity - Class 3	> 40				

Discussion

The special police units as integral part of the general police organization are important for protection of the constitutional order, because its duties are of special interest for the internal security of the country. To provide total efficiency and flexibility of their functioning it is necessary to fulfill the quality criteria which are set. It includes careful performance of the projected work program which includes wide spectrum of fundamental and applied knowledge and skills. A compulsory component of this program is maintenance and inspection of the biomotor skills that are observed and evaluated constantly during the year in accordance with previously established biomotor standards (Ivanovski, Janevski, Nedev 2010). Keeping to this dynamics, a real need emerges to extend the existing program of work of these units by installation of initial system for observation and control of the body status, in other words, the physical appearance of the members. To start this process, at the beginning, it is important to determine the method and limit values (standards) that will be used for assessment of the anthropometric characteristics of the given police population (Wilsgaardet al., 2005). In order to provide more sophisticated approach for diagnosing and controlling of the body composition it is very important to use the real BMI criterion.

There are various normative standards in the literature (National Institutes of Health, 2005; World Health Organization, 2008) with regard to the gender, race, profession, constitution etc. for BMI calculation, and even more methodological discrepancies regarding the normative standard to be used for the anthropometric characteristics of the given police population. Generally, most acceptable normative standard for BMI calculation is the medical, in other words, the epidemiological standard, but in this

research we chose the sport standard (Zaciorski, 1982), because the police population which have been analyzed participates regularly (every day or periodically) in trainings in accordance to the plans and programs for these units (Kljaic, 2005). According to this, the biomotor training in which the police units participate, is directed towards the development and maintenance of the basic biometer capabilities (force, stamina, speed, mobility, counterbalance and preciseness) and toward the obtaining of certain skills, knowledge and habits (swimming, diving, wrestling, skiing, alpinism etc.) which are needed for the performance of the specific professional tasks.

In determining the limit values according to the sport and normative BMI standard, certain knowledge about the anthropometric standards applied in the police systems in some of the Western European countries are being used. The police officers of the police departments in USA (Employment Standards for Michigan Law Enforcement Officers, 2003), Australian (Australian Federal Police, 2004) and Scotland (Scotland Police, 2008) regardless of their age, gender and difficulty of the police activities must have adequate anthropometric status, in other words, to be part of the population with minimal health risk. According to their standards, police officers with BMI values under 19 kg/m² and BMI values above 30 kg/m² are part of the category of individuals with inadequate, in other words, unacceptable body status.

Comparing the data received from the anthropometric standards research, we can ascertain that the BMI of both groups of respondents and the average BMI values are in accordance with the needs of the police profession, but in the upper zone of acceptable index values (BMI< 30 kg/m²). Regarding the distribution of BMI, the biggest part of the police population (65%-70%) is part of the overweight category (with almost equal percentage representation of representatives based on muscle mass and body fat), normal weight category (12%-21%) and obesity-class 1 (9%-22%), and at the end, the underweight category with only 1%.

Conclusions

In order to receive initial knowledge of the body status of the representatives of the special police units in the Republic of Macedonia, a body composition assessment of 160 respondents with the use of the BMI method (BMI-Body Mass Index) was performed. To offer an optimal model that will be used to observe and control the body composition of the population that is researched, we used the most feasible BMI criterion and we used the most relevant knowledge about the anthropometric standards that are used in the majority police stations in the world. Based on the results obtained from the statistical analyses which were conducted and the body composition assessment performed in accordance with the sport and normative BMI criterion, generally, the body composition is adequate and in accordance with the professional demands, but there are respondent with inadequate and professionally unacceptable BMI. To improve this situation we need to continuously observe and control the body composition status, that in a near future, if incorporated in the work system of these police units will give the intended results.

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METRICAL CHARACTERISTICS OF THE TEST FOR DETERMINING REACTION SPEED USING SIMPLE MOVEMENT WITH CHILDREN OF PRESCHOOL AGE

UDC:796.012.12-053.4
(Original scientific paper)

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Abstract

This study was conducted in order to analyze the metrical characteristics of the test for determining reaction speed using simple movement with children of the preschool age. The sample group of 96 both sex preschool children, average age of 5,91 ±0,49 decimal years, was subject to a specially constructed system for regulating reactionary speed using simple movement. The computerized system consisted of a measuring board with a control light, a system for transferring the signal to the computer and software for registering and storing data. The subjects were in a standing position, positioned at arm's length waiting for the signal light to flash, at which they would as swiftly as possible reach out and touch the measuring board. The task was conducted in five uneven intervals, randomly generated by the software. The data of the five task performances comprised the composite variable, which was then used for analyzing the metrical characteristics of the measuring process by using the RTT11G Script program in the statistical package IBM SPSS 20. The determined measures were: Kaiser's measures of adequacy PSI2 (0,96), Spearman-Brown-Kuder-Richardson-Guttman-Chronbach alpha measure of reliability (0,87), Lord-Kaiser-Caffrey beta measure of adequacy of the first main component (0,87), Momirić's lower border of reliability BETA 7 (0,90) and Guttman-Nicewandor coefficient RHO measure of reliability under Guttman's model of measuring (0,95). All of the measures mentioned showed satisfying results which enabled us to conclude that the process of measuring that was used gave satisfying results with children of the preschool age. Analysis of the applicability of the measuring process showed that in practical use of the analyzed system it is enough to do 3 attempts with one trial attempt, which provides the necessary level of reliability of the measurement.

***Key Words**: response time, arm movement, measuring, children, reliability*

Introduction

Reaction time, defined as the time between presentation of a stimulus and initiation of a response to that stimulus, is one of the most commonly used measures of neurological function. A common paradigm for assessing reaction time is to measure the time between presentation of a light stimulus and subsequent pressing of a response button or switch (Crabtree, & Antrim, 1988). This method is considered acceptable for determining reaction time, although the measured interval actually represents response time, the sum of reaction time and movement time. Many different types of reaction times can be measured, including responses to visual, auditory, and tactile stimuli (Schmidt, & Lee, 2005). Simple reaction time paradigms involve only one stimulus and require only one action in response. In these situations, the desired response is known in advance of the presentation of the stimulus. In choice reaction time paradigms, on the other hand, 2 or more different stimuli are involved. The stimulus conveys information about the desired response, so that the subject cannot anticipate which movement to make. Some researchers have demonstrated that reaction time increases with age in adulthood (Kiselev, Espy, &Sheffield, 2008), but no evidence about gender differences (Deary, & Der, 2005).

Relatively little is known about the nature of development of processing speed in very young children. In the developmental literature, one account of the mechanism underlying age differences in processing speed is a general developmental mechanism (Cerella, & Hale, 1994; Kail, 1993). Kiselev at al. (2008) also reported process-specific, age-related differences in processing speed in preschool children that support heterochronicity of brain development during childhood were revealed. There are few accounts

on the reliability and validity of the instruments used for measuring the reaction speed in small children. Determining the validity of the measurement process was mostly achieved through the test-retest method, calculation of the coefficient of correlation or determining the interclass cross asset correlation, as well as determining the Cronbach alpha coefficient of reliability. The measuring procedures are usually computerized (eg. Deary, Liewald, & Nissan, 2011) which are based upon a specially designed software and displaying of the stimulus on a computer screen. Apart from registering the speed of a reaction to a stimulus, these systems also enable multiple choice reactions. While working on a larger project which, among other things, consisted of assessing the motor skills of children of the preschool age we have constructed a special computerized system for measuring the time of reaction using simple hand movement. The assessment of the metrical characteristics of the measuring procedure using this system is the subject of this research. We were interested in the reliability, representability, homogeneity, and discrimination ability of the measurements on children of the preschool age while using this system.

Material & methods

The research was conducted on a sample of 96 children of the preschool age, belonging to both sexes, their average age being 5.91±0.49 decimal years. All the children attended preschool institutions in the city of Novi Sad, they were healthy and without any recorded mental or physical issues. The measurement was conducted during October of 2013 in the faculty and the preschool institution "Petar Pan" in Novi Sad.

In order to measure the reaction speed of the children's simple hand movement a unique measuring instrument was constructed; it consisted of two parts, an electromechanical part and a software part. The electromechanical part consisted of a copper block which acted as the touch sensor, one red diode light, a portable cable and a notebook computer which enabled the registration of the incoming signal from the measuring board and general software support. The software part of the instrument was a specifically written program – RefleXz (Figure 1) which had several functions, the most important of them being: formulating a list of users with basic data, adjusting the sensitivity of the measuring board (calibrating), adjusting the way in which the light signal was being given (manual, random), the number of times and interval in which the light signal appeared, as well as storing data and exporting it into MS Excel.

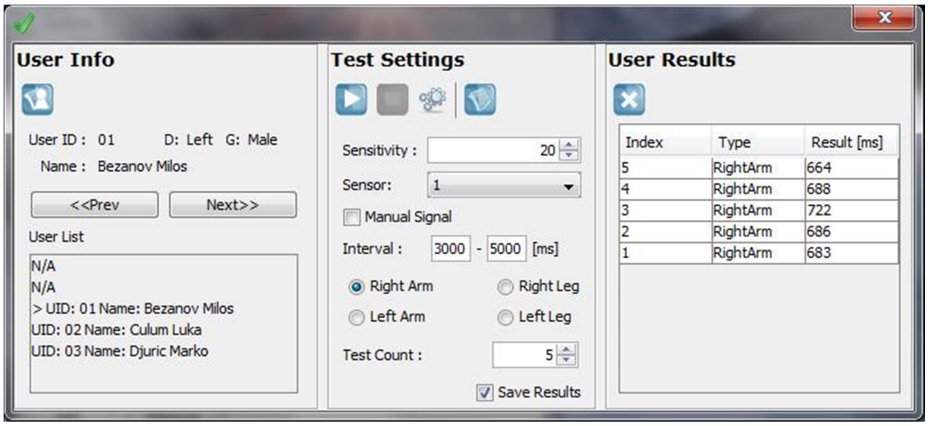

Figure 1.The main window of the test reaction time in RefleXz with preset parameters

Apart from the instruments and gear already mentioned, the measuring process also required additional space next to the wall bars of a 2x2m diameter, a table, and an available outlet of electrical energy. The measuring board would then be fastened, shoulder high, to the wall bars using two velcro straps, and from there connected to the computer using the appropriate cable. Before the measuring process the measuring board's sensitivity was calibrated to an optimal value.

The measuring protocol consisted of the following steps: the subject stood facing the board on a distance appropriate to the length of his/hers outstretched arm, so that the palm of his/her hand was resting on the board (Figure 2); once the necessary distance was establish the subject had to stand still, in an upright position with arms lowered to the sides of the body; for completion of the task, the subjects used their dominant hand. The task consisted of performing five consecutive movements of the arm, as quick as possible, until the hand met the surface of the measuring board, upon seeing the light signal.

After completing each stage of the task, the subject would return their arm to the initial position. If any premature arm movements made, or any unanticipated event occurred, or if there was any sort of interference, the attempt would be repeated so that five proper attempts were registered. There were no trial runs. The measuring instrument was adjusted so that the light signals appeared in random intervals (3000-5000ms), and the results were record in milliseconds.

Figure 2. Start position of body, arm position and contact with the measuring board

For all five attempts some basic descriptive statistics were calculated, the mean, standard deviation and coefficient of variation, and tested for normality of distribution using the Kolmogorov-Smirnov test. The data of the five task performances comprised the composite variable, which was then used for analyzing the metrical characteristics of the measuring process by using the RTT11G script program (Momirović, Wolf &Popović, 1999) in the statistical package IBM SPSS 20 (SPSS ID: 729225). The determined measures were:

- Kaiser's measures of adequacy PSI2 - measure of Sampling Adequacy (MSA) is an indicator of factorability for a collection of variables,
- Sperman-Brown-Kuder-Richardson-Guttman-Chronbach ALPHA - measure of reliability based on the classical summation measurement model that takes into account all particles, in quantitative terms,
- Lord-Kaiser-CaffreyBETA - represents the reliability of the first principal component, which means the priority of the calculation is the principal component and the projection of a single particle on it.
- Momirić's BETA7 - lower border of reliability,
- Guttman-Nicewandor coefficient RHO - measure of reliability under Guttman's model of measuring.
- Momirović's H2 - measure of homogenity that tends towards the maximum, the unit values, in those cases where the main subject of measuring predominantly enhanced when the scale is probably one-dimensional structures.

Results

Before the analysis of the metrical characteristics of the test for determining the reaction time using simple arm movement, an analysis of the basic descriptive statistics was conducted, along with the testing the importance of differences between boys and girls. In all the measuring items it was determined that the boys reached higher average values than the girls. However, the analysis of the speed of the simple arm movement of children of both sexes (Table 1) showed that there was no statistically significant difference in any item. It was also determined that the distribution of results between the items does not stand out in a statistically relevant manner from regular distribution. These findings enabled us to conduct further analyses on the entire research sample regardless of their gender by applying the standard parametric statistical procedures.

The relation of average values and standard deviation of the measurement particles indicates a

somewhat increased homogeneity of the result distribution but the discrimination ability of the test can be interpreted as satisfying. The coefficient variation value is somewhere in between 12.24% and 17.73%.

Results should be presented precisely and should not contain material that is appropriate in the discussion. Units, quantities, and formulas should be expressed according to the International System (SI units). All measurements should be given in metric units.

Table 1.Basic descriptive statistics and the results of the differences between boys and girls

ITEM (ms)	GENDER	MEAN	SD	CV	KS	SIG.	T	SIG.
Reaction Time 1	Male	650.43	104.61	16.08	.71	.69	-1.01	.32
	Female	671.62	94.37	14.05				
Reaction Time 2	Male	662.73	112.33	16.95	1.15	.14	-.39	.70
	Female	671.18	93.29	13.89				
Reaction Time 3	Male	647.16	104.07	16.08	.79	.56	-.59	.56
	Female	683.87	83.75	12.24				
Reaction Time 4	Male	668.70	118.59	17.73	1.32	.06	-.59	.93
	Female	682.49	102.45	15.01				
Reaction Time 5	Male	693.93	118.81	17.12	.94	.34	-.36	.72
	Female	702.36	97.96	13.94				

Legend: ms - millisecondes; MEAN – average value; SD – standard deviation: T – t test value; SIG – signification; KS – Kolmogorov-Smirnov test; V – coefficient of variation (%)

The average item correlation was on a satisfactory level and it indicated a well defined first measuring subject (Table 2). This was confirmed by the high value of Caiser's PSI2 coefficient of the variable sample's adequacy ($\psi 2 = .954$), as well as a high representability of all the items. The overall reliability of the test is on a satisfactory level ranging from .877 on the classical summation model of measuring, to .961 on Gutman's model of measuring (Guttman, 1953). Momirović's lower border of reliability has a high value as well (.902). The assessment of the item's homogeneity showed a satisfactory value.

Table 2.Basic descriptive statistics of items and the results of the metric characteristics of items and the entire test

			Intercorrelations							
ITEM (ms)	MEAN	SD	1	2	3	4	5	REP	REL	H
Reaction Time 1	659.13	100.57	1.00					.94	.32	.61
Reaction Time 2	666.20	104.49	.58	1.00				.96	.66	.89
Reaction Time 3	662.23	97.48	.59	.76	1.00			.96	.67	.89
Reaction Time 4	674.36	111.89	.44	.56	.60	1.00		.97	.46	.79
Reaction Time 5	697.39	110.25	.43	.59	.54	.67	1.00	.96	.43	.75

Cronbach α =.877 ; Momirovic $\beta 7$ = .902 ; Lord-Kaiser-Caffrey β = .878
Guttman-Nicewander ρ = .961 ; Caiser $\psi 2$ = .954 ; MomirovicH2 = .865
Average Correlation = .589

Legend: REP – measures of item adequacy; REL - measures of item reliability; H – correlation of items with first common component

The second and third item had the highest projection on the first main component, the first item had the lowest, which showed low reliability as well. After repeating the task for the third time the correlation values with the first subject of measuring show significant decreases in value. The average values of the items showed a tendency to grow, but those values express stability and balance after the first attempt.

Discussion

Some authors pointed our problems with distributing data received from assessing the speed of reaction (Whelan, 2008). They list the appearance of asymmetrical distribution with result grouping in the

zone of lower values and the appearance of extreme results in the zone of higher values. This research showed the appearance of such characteristics on the sample of preschool children as well (Figure 3). A graphical analysis of the distribution of the measurement's five particles data showed that the described asymmetry of distribution is more present with completed items, especially with the fourth item. The linearity of the relation is most expressed with the first three items, and later on drops off with the end items. This can probably be attributed to loss of attention and concentration in the last attempts of performing the task in small children. If the previously mentioned low correlation of last items with the first subject of measurement and the low coefficient of reliability are added to this, then it is possible to deduce that five consecutive repetitions of measurement was too much for a stable assessment of reaction speed in preschool children.

These findings suggest that for an optimal assessment of reaction speed in preschool children, using this system, three attempts, with one trail attempt of the given task, would be enough. This is confirmed by the calculation of Cronbach's alpha coefficient value for the first three items, which is slightly lower at .845 without performing the trial attempt.

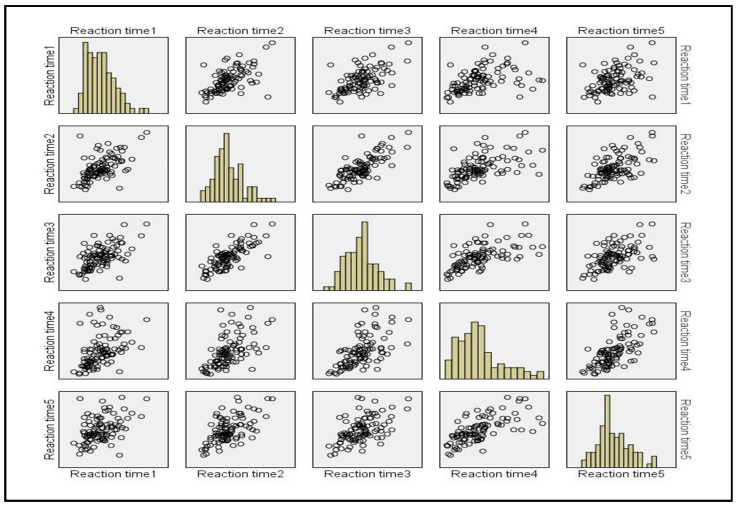

Figure 3. Matrix Scatter and Distribution graphs for all five items

All the values of reliability attained by applying this system for measuring the reaction speed using simple arm movement in children of the preschool age, significantly surpass the limit of good reliability of .80 (George, & Mallery, 2003), and some, primarily under Gutman's model of measuring, have a value of over .90 which is considered as an excelent value of reliability of the measurement. The representability of the test as a whole, and some of its items, is high and indicates a good level of informativeness of the measuring process.

Conclusions

The protocol that was applied in measuring the reaction speed of simple arm movement in children of preschool age showed good metrical characteristics. The reliability of the measurement values were high as was the representability of the test. The practical application of the constructed aparatus showed itself to be precise and with small corrections, primarily of the measuring protocol, could be standardized. A conclussion was reached that for the optimal measuring of reaction speed using simple movement in preschool children 3 attempta at completting the taks were necessary, with one trial attempt. By applying a simple protocol for measuring, with software and accompanying tools, the system can be recommended for further use, especailly with small children.

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THE INCIDENCE OF POSTURAL DISORDERS WITH REGARD TO DEGREE OF NUTRITIONAL STATUS IN CHILDREN FROM 7 TO 10 YEARS OF AGE

UDC:616.711.007.7-053.5
(Original scientific paper)

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Abstract

Postural disorders and disorders of nutritional status in children are quite frequent and also carry various risks of possible health problems. The aim of this research was to analyse postural disorders in younger school-age children, 7 - 10 years old, as well as their incidence with regard to category of nutritional status and gender dimorphism. The sample of subjects comprised of 335 younger school-age children, 7 - 10 years old, of both genders (174 girls and 161 boys), pupils of the primary school "Sveti Sava", Bačka Palanka. Postural status was assessed by Napolen Volansky method. Data processing involved statistical package SPSS for Windows, version 15. In establishment of differences in postural status, with regard to the age and the gender dimorphism, we used χ^2 test. In order to establish differences in cumulative evaluation of postural status, we applied rank-sum Mann-Whitney Z-test, which is equivalent to T-test for categorical data. In establishment of differences in groups of subjects formed on the basis of degree of nutritional status, we applied Kruskal-Wollis test. According to the obtained results, total evaluation of postures of children of both genders established no statistically significant differences, yet that higher rank was established in girls, which indicates to poorer bad posture in female subjects (7-8 years of age: Z=-0.133; p=0.894; 9-10 years of age: Z=-0.993; p=0.321). Through analysis of distribution of nutritional status categories, formed on the basis of the BMI determined according to the gender, it was established that the difference is at the limit of statistical significance in children of 7-8 years of age (χ^2 = 7.401; p = 0.06). In children of 9-10 years of age, no statistically significant difference was established. Statistically significant difference in incidence of postural disorders with regard to category of nutritional status was noticed in the subsample of children of 9-10 years of age (χ^2 = 53.802; p = 0.000). These results lead to conclusion that younger school-age children should get involved in organized and continuous physical activities in order to prevent occurrence of postural disorders and obesity.

Key words: *body posture; obesity; BMI; prevention.*

Introduction

Postural disorders of locomotor apparatus can occur at any age, although there are certain periods of life in which the body is more susceptible. These are periods in which children are particularly sensitive, for example, the start of school, so the people participating in their upbringing should be extra careful (Protić - Gava, Romanov, 2008). Good overall health, appropriate muscle control, muscle strength and elasticity, favourable psycho-sociological factors (e.g. self-confidence) reflect proper body posture (Protić - Gava, 2008). Good body posture is natural and spontaneous, biomechanically rational and aesthetically likeable.

The number of school children with postural disorders is growing, which can result in serious health problem unless eliminated on time (Protić - Gava et al., 2009). There are various causes of spinal deviations such as obesity, malnutrition and insufficient physical activity (which decrease when starting the school).

Health problems connected with obesity during the childhood may be twice as dangerous due to social and psychological problems which are long lasting and tend to worsen during the adulthood (Dean, Flett, 2002). The prevalence of obesity during the last two decades is still increasing, both in small and in

industrially developed countries (Centres for Disease Control and Prevention, 2012). The fact that the number of obese children and adolescents has tripled during the last three decades is alarming. In 2011-2012, 8.4% children of 2 to 5 years of age were obese, as compared to 17.7% children of 6 to 11 years and 20.5% adolescents of 12 to 19.

The aim of this study was to analyse postural disorders in younger school-age children of 7 to 10 years of age, to analyse nutritional status, differences in gender as well as their incidence with regard to category of nutritional status.

Material & methods

The study represents a cross-sectional study and was carried out in the primary school "Sveti Sava", Bačka Palanka, Serbia. The sample comprised of 335 younger school-age children, 7 to 10 years of age, of both genders (174 girls and 161 boys) classified in two categories: 7-8 (161), 9-10 (174). The research also comprised the children exempted from classes of physical education.

Postural status was assessed by Napolon Volansky method. Eight segments were observed as postural status indicators: head posture, shoulder posture, chest (thorax shape), shoulder blades posture, side spinal curve, abdominal wall posture, shape of legs and feet posture. Correct posture was graded with 0, minor deviations were graded with 1, and major deviations with 2. By summing up all the indicators of postural status, we obtain the collective estimate based on which the subjects are categorised: 0 points – excellent posture; 1-4 points – very good posture; 5-8 points – good body posture; 9-12 points – poor body posture; 13-16 points – very poor body posture.

The parents of the subjects participating in the research gave their written consent. The research was carried out by the sport doctor, BSc in Kinesiotherapy and the teacher of sport and physical education. Assessment was performed during the classes of physical education. All the subjects were exposed to the same conditions. Postural status was assessed by means of standard procedure stipulated by the said method. Namely, in order to provide general image of individual body postures, body constitution and relations of specific body parts, the subject was observed as a whole from the distance of 2 meters, from frontal and sagittal plane. Assessment was preceded by marking of *processus spinosus* of vertebral column, internal edges and lower angles of shoulder blades, and *spinae iliacae posterior superior*. When assessing the body status and the feet status, the subject (minimally dressed and barefoot, wearing underpants only), takes relaxed standing posture looking ahead and with arms relaxed and lowered. With such posture, the body mass should be equally distributed to both feet, which are slightly separated and parallel. This posture gives the real image of the spinal curve. The results of the assessment were entered in personal records prepared exclusively for the needs of this research.

Table 1. Distribution of collective estimates of posture in total sample of subjects with regard to the gender

Estimate	Statistics	Age					
		7 – 8 years of age			9 – 10 years of age		
		Gender		Total	Gender		Total
		M	F		M	F	
Excellent posture	Number	15	17	32	12	15	27
	% Gender	20.0%	20.2%	20.1%	14.3%	16.9%	15.6%
Very good posture	Number	19	27	46	24	20	44
	% Gender	25.3%	32.1%	28.9%	28.6%	22.5%	25.4%
Good posture	Number	38	38	76	46	46	92
	% Gender	50.7%	45.2%	47.8%	54.8%	51.7%	53.2%
Poor posture	Number	2	2	4	2	8	10
	% Gender	2.7%	2.4%	2.5%	2.4%	9.0%	5.8%
Very poor posture	Number	1	0	1	0	0	0
	% Gender	1.3%	.0%	.6%	0%	0%	0%
Total	Number	75	84	159	84	89	173
	% Gender	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
		$\chi^2 = 2.013$	p = 0.733		$\chi^2 = 4.156$	p = 0.245	

Assessment of nutritional status was executed on the basis of the values of the Body Mass Index (BMI), calculated as the ratio of the body mass expressed in kg and the square of height, expressed in meters - $BMI=TM/TV^2$ - kg/m^2, where we used the criteria suggested by the World Health Organization (Ogden et al., 2002). The values below 5 percentiles were corresponding to undernourishment, the values

between 5 and 85 percentiles – normal nutritional status, the values between 85 and 95 percentiles to the increased risk of obesity, and the values above 95 percentiles – excessive body mass.

Data processing was performed by means of non-parametric methods, χ^2 - test for establishment of differences in postural status with regard to the gender. Kruskal-Wollis test was applied for testing of the differences between the groups of subjects.

Results

Distribution of collective estimates of posture by gender is presented in Table 1. There are some differences in terms of gender dimorphism, but they are not statistically significant. Girls of 7 to 8 years of age have better body posture as compared to boys of the same age, whereas at the age of 9 to 10, their posture is worse as compared to boys of the same age.

Table 2. Distribution of estimates of nutritional status by gender of subjects in total sample

Group	Statistics	Age					
		7 – 8 years of age			9 – 10 years of age		
		Gender		Total	Gender		Total
		M	F		M	F	
Undernourished	Number	1	5	6	3	5	8
	% Gender	1.3%	6.0%	3.7%	3.6%	5.6%	4.6%
Normal weight	Number	60	71	131	68	72	140
	% Gender	77.9%	84.5%	81.4%	81.0%	80.0%	80.5%
Risky higher weight	Number	10	7	17	8	10	18
	% Gender	13.0%	8.3%	10.6%	9.5%	11.1%	10.3%
Overweight	Number	6	1	7	5	3	8
	% Gender	7.8%	1.2%	4.3%	6.0%	3.3%	4.6%
Total	Number	77	84	161	84	90	174
	% Gender	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
		$\chi^2 = 7.401$ r = 0.06			$\chi^2 = 1.131$ r = 0.77		

Analysis of distribution of categories of nutritional status formed on the basis of the BMI by gender of the subject (Table 2), shows that in category of 7-8 years of age, there are differences between boys and girls at the limit of significance; in girls, the number of undernourished subjects is higher, whereas in boys, there are more of those that are overweight. In category of 9-10 years of age, no statistically significant differences were observed in distribution of estimates of nutritional status by gender of the subjects.

Table 3. Distribution of estimate of nutritional status and postural status in subjects of 7-8 years of age

Posture estimate	Statistics	Groups by BM index				Total
		Undernourished	Normal weight	Risky higher weight	Overweight	
Excellent posture	Number	1	28	3	0	32
	% for BMI groups	16.7%	21.5%	18.8%	.0%	20.1%
Very good posture	Number	1	40	5	0	46
	% for BMI groups	16.7%	30.8%	31.3%	.0%	28.9%
Good posture	Number	4	59	7	6	76
	% for BMI groups	66.7%	45.4%	43.8%	85.7%	47.8%
Poor posture	Number	0	3	0	1	4
	% for BMI groups	.0%	2.3%	.0%	14.3%	2.5%
Very poor posture	Number	0	0	1	0	1
	% for BMI groups	.0%	.0%	6.3%	.0%	.6%
Total	Number	6	130	16	7	159
	% for BMI groups	100.0%	100.0%	100.0%	100.0%	100.0%
	Testing of differences	$\chi^2 = 20.241$		p = 0.063		
	Correlation (gama)	$\gamma = 0.221$		p = 0.180		

Analysis of correlation of collective estimates of postural status and categories of nutritional status depending on the age of subjects is presented in Table 3 (for the category of 7-8 years of age) and in Table 4 (for the category of 9 -10 years of age). Analysis of body posture depending on the nutritional status in subjects of 7-8 years of age, shows that majority of subjects (130) with normal weight, has better

postural status. Correlation between the postural status and the degree of nutritional status does exist, but the analysis of the results indicates to the fact that at this age, it is not statistically significant, that is, deviations from normal postural status are minor.

In category of 9 to 10 years of age, there is statistically significant correlation of distribution of estimates of postural status of subjects and their nutritional status (p=0.001). In category of children of 9 to 10 years of age, there is statistically significant correlation of distribution of postural status of subjects and their nutritional status. The trend of distribution of postural disorders depending on the degree of nutritional status is reflexed as in children of younger age. The majority of subjects (161 children) is distributed into first three categories with better postural status and there are representatives of all four categories of nutritional status.

Table 4. Distribution of estimates of nutritional status and postural status in subjects of 9-10 years of age

Posture estimate	Statistics	Groups by BM index				Total
		Undernourished	Normal weight	Risky higher weight	Overweight	
Excellent posture	Number	1	25	1	0	27
	% for BMI groups	12.5%	18.0%	5.6%	.0%	15.6%
Very good posture	Number	3	37	3	1	44
	% for BMI groups	37.5%	26.6%	16.7%	12.5%	25.4%
Good posture	Number	4	76	9	3	92
	% for BMI groups	50.0%	54.7%	50.0%	37.5%	53.2%
Poor posture	Number	0	1	5	4	10
	% for BMI groups	.0%	.7%	27.8%	50.0%	5.8%
Very poor posture	Number	0	0	0	0	0
	% for BMI groups	.0%	.0%	.0%	.0%	.0%
Total	Number	8	139	18	8	173
	% for BMI groups	100.0%	100.0%	100.0%	100.0%	100.0%
		$\chi^2 = 53.802$		p = 0.000		
		$\gamma = 0.529$		p = 0.001		

If we observe the changes in trends of postures on one hand, and the nutritional status on the other hand, in both age categories, we can notice slight increase in categories with higher nutritional status and parallel decline in collective estimate of the posture. This results in statistically significant correlation of the postural status and the degree of nutritional status in children of older age. In other words, excessive weight worsens body posture and increases collective estimate according to Volansky (higher grade = worse posture).

Discussion

Younger school-age girls (7-8 years of age) show significantly higher incidence of deviated body posture as compared to boys of the same age. The assumption is that in girls of this age the occurrence of hypokinesia is probably more expressed, as they spend more time in sedentary position (games, reading, TV etc.), which, together with other factors, results in postural disorders. Boys of the same age are more active, they are moving more and are more involved in sport activities. Also, these changes in girls of the age of 10 coincide with the period of entering into the puberty, which starts slightly earlier than in boys. The period of puberty is characterized with increased excretion of the growth hormone and the reproduction hormones, which results in increase of all skeletal, muscular and fat cells. This influence is not the same for all body cells. Skeletal system develops faster than the muscular. Due to faster development of the skeleton, muscles and ligaments get elongated, strained and weak, which can, because of the influence of external factors, result in postural disorders (Ugarković, 2001). Vuković (2000), as well as Medojević and Jakšić (2007) came to conclusion which also confirms that the periods of posture deviation coincide with the period of entering into puberty.

The trend of being categorized in certain category by nutritional status regardless of the gender is continued in school age, as well. Namely, the results of the study published at the pre-school population of both genders (Srdić, Obradović, 2006) indicate to incidence of overweight in 12.02% of boys and 6.99% of girls, while the risk of obesity (pre-obesity) was reported in 10.89% boys and 12.11% of girls. Apart from increased incidence of overweight, boys were more undernourished (7.64%) as compared to girls.

As different to the said study, in which, for estimation of obesity, apart from the BMI, they also used the percentage of the fat mass in the total body mass, slightly more believable for discussion as only BMI was used as the status indicator, we can see the study carried out at the pre-school age children, of 5 to 7 years of age. The research was separately conducted in boys (Obradović et al., 2006a) and in girls (Obradović et al., 2006b). Comparing the results of these two studies, one will come to interesting conclusions: the least number of subjects in undernourished (regardless the gender), and in the group prone to obesity, the results are homogenous (11-13% boys and 11-12% girls), and the obesity goes in favour of the boys (10-15% versus 4-8%).

The existence of correlation between the postural status and the degree of nutritional status in children is also supported by the research conducted by Protić-Gava (2008), of which the objective was to establish the incidence of good or poor body posture with regard to category of nutritional status in school children. The results of incidence of good and poor posture in the total number of subjects with regard to category of nutritional status, coincide with the results of this research and indicate to statistically significant difference on the level p=0.00 in distribution of good and deviated body posture by categories of nutritional status.

Conclusions

Analysis of the obtained results indicate the fact that the greatest percentage of the subjects with normal nutritional status falls within three categories of subjects with good body posture (excellent, very good, good), while poor body posture is observed in subjects with risky and overweight nutritional status. Occurrence of structural changes at this age is sporadic, but what brings the worry is high percentage of functional disorders.

The results of this research lead to two general conclusions. The first one indicates the necessity of more quality organization of sport activities, both in school and out of school. Generally speaking, the lack of adequate space incapacitates normal performance of classes of physical education. Particular problem is seen in younger classes, where the latest reforms again did not enable teachers of physical education to work with children from 1st to 4th grades. Off-educational physical activities are sporadic, poorly organized, often left to rare enthusiasts, and with rather narrow possibility of selection, particularly for young females, who are additionally problematic due to acquired functional postural deformities.

The second general conclusion refers to necessity of cooperation of parents, health and educational institutions, in order to prevent and timely rehabilitate functional disorders of body postures which might occur, and which, if treated in the very beginning, can be relatively simply and successfully removed. By bringing together these two conclusions, we form an attitude that the role of the parents is indispensable in forming, not only spiritual but also physical status of their children, thus the support with positive attitudes, in that sense, must be provided by health and educational institutions and by the government as well.

Conflict of interests

There is no conflict of interests

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TREND OF THE CHANGE OF THE ANTHROPOMETRIC CHARACTERISTICS OF STUDENTS OF PHYSICAL EDUCATION AND SPORT IN THE PERIOD FROM 2008. TO 2012.

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(Original scientific paper)

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Abstract

Morphological space as only one segment of the human space of a man is often the subject of analysis, when one wants to determine the state of the somatic status of certain population. On a sample of 180 male students, of the Faculty of Physical Education and Sport in Eastern Sarajevo using longitudinal research methods, diagnosis of the basic anthropometric characteristics has been made in the function of monitoring the differences of somatic changes, of four different generations from 2008 to 2012 with the aim of determining the differences in the basic anthropometric characteristics. Anthropometric characteristics of the subjects were presented with the following variables: body height expressed in cm, body mass expressed in kg, and body-mass index (BMI), expressed in kg/m². The obtained results showed that in the students of Faculty of physical education and sports during the four-year period, a statistically significant trend differences occurred that have defined substantial heterogeneity of the population. In analyzing the data, using the T-test, the obtained results significantly explain differences in anthropometric characteristics at the level of significance ($p<0.01$) and for Body Height ($T=2.70$), Body Weight ($T=3.55$), BMI ($T=1,98$). Based on the obtained results, it can be safely argued that the process of growth and development of the student population that enters the Faculty of Physical Education and Sport is heterogeneous and that it is the result of numerous endogenous-exogenous factors during the maturation of an individual.

Key words: *students,the trend of changes, anthropometric characteristics, Body Mass Index.*

Introduction

One of the most important health issues of modern society is obesity, and worst of all, it seems to have a large negative impact on children. Even 13-14% of children in the U.S. are defined as obese, while in England it is 10-17%. In 2001, researches about obesity, which included six countries (Brazil, United Kingdom, Hong Kong, Netherlands, Singapore and the United States) found that children aged 4-11 have overweight rate of 2-3%. Between 1984. and 1994. the number of obese children has increased to 50% (Jebb et al., 2003). As the best method to prevent and stop this rapid growth in obesity is a combination of regular physical exercise and a balanced nutrition (Nakeeb et al., 2007). The study aimed at analysis of weight and overweight of children based on body mass index (BMI) and triceps skinfold (TSF) conducted Planinšec & Fošnarič, in 2009. The sample included 5,613 children aged 6 to 12 years (Mean=9.23±1.69) from Slovenia. The results showed that 18.3% of boys and 18.5% of girls are overweight and 6.5% of boys and 6.7% of girls are obese. The correlation between BMI and TSF in boys ($r=0.785$) and in girls ($r=0.783$), is almost identical. Body weight has a lower correlation with TSF in boys ($r=0.691$) and girls ($r=0.631$). It has been proved that there is a significant difference ($p<0.001$) in the TSF according to body weight. Booth, et al. (2003) conducted a study in order to determine changes in the prevalence of overweight and obesity among young Australians (aged 7-15 years), 1969-1985. ended in 1997. year. Data from 5 independent population surveys were analyzed: Australian Youth Fitness Survey, 1969, Australian Health and Fitness Survey, 1985 South Australian Schools Fitness and

Physical Activity Survey, 1997, New South Wales Schools Fitness and Physical Activity Survey, 1997 and Health young Victorians study 1997). The results showed that between 1985 and 1997., the prevalence of overweight and obese population has increased by 60-70%, obesity 2-4 times and a combination of body weight and obesity has doubled. The findings were consistent for both sexes. For the period 1969 to 1985 there were no changes in the prevalence of overweight and obesity in girls but among boys the prevalence of overweight increased by 35%, the prevalence of obesity has tripled, and the prevalence of overweight and obesity combined has increased by 60%. Studies of some authors in addition to monitoring of body dimensions follow the trend of development of motor skills.

Westerstahl, et al. (2003). To investigate changes over time in body dimensions, and muscular and aerobic fitness in a representative sample of 16-year-old-girls and boys in secondary schools in Sweden from 1974. to 1995. (n=855). Height and weight were measured and five tests were performed: run–walk, two-hand-lift, Sargent jump, sit-ups, and bench-press. Results in 1995, girls and boys had higher body mass index (BMI) than in 1974. Girls and boys performed less well in bench-press, sit-ups, and run–walk-tests in 1995. Boys, but not girls, performed better in Sargent jump in 1995 than in 1974. Girls and boys performed better in two-hand-lift in 1995 than in 1974. However, after adjustment for body dimensions, there were no differences in performance in two-hand-lift or run–walk-tests between 1974 and 1995. In conclusion there was a decreased aerobic fitness and an increased maximal static strength among adolescents in Sweden between 1974 and 1995. These changes were partly due to increased BMI. However, decreased daily physical activity level cannot be excluded as a contributing factor to the decreased aerobic fitness. The reduced performance in muscular endurance in 1995 was not related to increased BMI. Instead, it is suggested that it is to be related to a specific decrease in hip flexion and arm muscle endurance. The results of the six-year follow-up of 296 patients (aged 10 to 16 years in 2001 and 2007) by Ekblom et al. 2009 showed that there are no differences in BMI in sixteen year olds and low values of aerobic capacity and high BMI at age 10 years predicts obesity at the age of 16. There was no difference in the prevalence of overweight plus obesity between the sample 2001 and 2007. As a conclusion it was stated that normal weight and good aerobic fitness at 10 years old children reduce the risk of elevated BMI in relation to 16-year olds. Diagnostics of body weight is often the subject of research by which one can gain a real insight into current status of a defined population and the possible negative trends of growth and development over a certain period of time (Sorensen et al. 2000a; Dopsaj, et al. 2005). Certain studies have investigated the problem of athletes and their parameters of anthropological status. In a study conducted in Turkey, on 153 men who have different levels of physical activity, BMI values were as follows: American footballers 27.76±5.18kg/m², volleyball players 24.49±2.90kg/m², basketball players 24.70±2.65kg/m², footballers 23.37±2.78kg/m², and for students who do not exercise regularly 23.42±3.62kg/m (Pelin et al. 2009) and percentages of body fat values were different with respect to gender and sport they do. Sınırkavak et al. in 2004 Values obtained values of subcutaneous fat tissue in men students of physical education and sport from 11.80±0.55%. In a survey conducted by Akın et al. in 2004 in five different sports, including 100 male athletes, subcutaneous body fat values were as follows: 13.06% wrestling, football 15.1%, 18.2% weightlifting, handball 20.8% and 16.8% of taekwondo. This is significant, although there is a number of studies to estimate physical fitness of anthropometric characteristics, there are not many studies on the physical proportions for a good physical condition. Part of the research with the handball players has confirmed that they have wide shoulders, narrow hips and middle chest latitude, and football players have a long body and narrow hips (Cakiroglu et al. 2002; Çıkmaz et al, 2005). In conclusion, the participants in this study were found to have a normal body mass index, RPI, WHR and fat percentage value. According to the physical structure they have medium body structure, with broad shoulders, narrow upper body and hips.

Also, in addition of active athletes the subject of research of some authors is the student population that is also at the stage of growth and development. Kurt, et al. IN 2011 conducted a survey in order to determine the physical proportions of Turkish students of physical education and sport. This study involved 258 men of physical education and sport who practice on a recreational level, age 22.40±2.75 years, body height: 178.67±9.43cm, weight: 73.44±13.64kg. They were evaluated in terms of BMI, RPI, WHR, percentage of body fat, index Cormique, Monourier index, Acromio-iliac index, Martin index, Biacromial index and hip index. The results were as follows: BMI: 22.86±2.66kg/m², RPI: 42.89±1.77cm/kg, WHR: 0.79±0.05%, percentage of body fat 14.43±4.41%, Cormique index of 51.51±1.58%, Monourier index 94.31±6.10%, Acromio-iliac index of 63.88±6.61%, Martine index of

6.11±0.48%, Biacromial index 22.32±1.86% and hip index 13.89±0.97%. Although the respondents showed normal-healthy BMI, WHR and percentage of body fat, they also showed a thicker middle section of the body, a narrow upper body and narrow hips. Vadas & Balogh (2012) in a study presented somatic profile and functional fitness of 19 female students of the Faculty of Physical Education and Sport, University of Presevo, age 19.5±0.9 years. The basic anthropometric parameters (body weight, height, BMI and percentage of body fat in the body) are measured. To assess the functional capabilities of maximal oxygen consumption, spiroergometry was applied. Analysis of the results showed that according to the percentage of fat, female students take upper zone which is recommended for athletic population, and despite the large volume of physical activity, their average values of the functional parameters are on the level of the standard population. Budakov, et al. (2012) are, using an anonymous questionnaire survey conducted research among 800 students from the University of Novi Sad, aged 20 to 24 years, of equal representation of gender structure in order to determine the nutritional status and physical activity of students. Older students had higher average BMI (Mean=24.49) than younger (Mean=23.36), as opposed to female students where younger have a slightly higher BMI (Mean=20.49) than older (Mean=20.37). There were 116 (29%) obese students, while 62 (15.5%) female students were underweight. Physically active were 451 (56.4%) students. Older students were physically more active, 481 (60.1%), compared to the younger, 399 (49.9%) ($p<.01$).

Students were found to have a sedentary lifestyle, 417 (52.1%) spending more than two hours a day watching TV and computer. Conclusion is that students are more inclined to obesity, and female students to malnutrition . Sedentary lifestyle is also present in a large percentage, more in the final year students. In the study Dopsaj et al. 2006 there were identified classification criteria for assessment of body mass index of students. The sample consisted of 311 female students of the Police Academy, aged 19 to 24 years with the aim of diagnosing BMI as key measure to assess the physical status and nutritional status. The results showed that the average BMI of the sample female students is 21.59±2.29kg/m², and the range of scores from 16.20 to 29.24kg/m². What is with the statistically significance established, is that already during the study 4.50% of the population of the female respondents belong to the category with a BMI value ranging from 26.38 to 29.24kg/m², and according to the current medical standards (or consensus) belong to the category of overweight (obesity medium) females, or category of individuals with inadequate, i.e. professionally unacceptable physical status. What is surprising is that in the category of underweight there are 11.58% (BMI below 19.1kg/m²) and in the category of anorexic it is even 1.61% of female respondents from the tested female student population (BMI below 17.5 kg/m²). Eisenmann & Malina (2002) conducted a study in order to examine secular changes in maximal oxygen consumption (VO²max) in the U.S. girls and boys using the available data from 20 century. Data (mean values) were divided by decade into three age groups: 6-12, 13-15, and 16-18 for boys, 6-11, 12-14, and 15 and 18 for girls. The results showed that the absolute and relative oxygen consumption remained relatively stable among boys and girls. In adolescent girls, particularly those aged 15 and older, VO²max consumption is reduced by approximately 20% during the last few decades. Available data showed that aerobic endurance is not reduced in young people in the United States, except in adolescent girls over the last few decades. Applying transversal research methods, Jankovic et al. 2007 on a sample of 267 male and 88 female students of the Police Academy (KPA) from Belgrade made a diagnosis of basic anthropometric characteristics in function of the study year. Basic anthropometric characteristics of respondents were presented by body mass, body height, body-mass index (BMI). The results showed that in the KPA students during their studies came to statistically significant trend change in increase of BM as key measure to assess the volume of the body (1.20kg per year of study) and with BMI, ie. nutritional status (0,42kg/m² per year of study). Compared to female students, the results showed that during the study KPA came to a statistically significant trend change in reductions in BMI, ie. nutritional status (-0.56kg/m² per year of study).

The problem of analysis of anthropological characteristics of students of the Faculty of Sport and Physical Education in Novi Sad researched Srdić et al. in 2009. The sample included 122 students of both sexes, and based on the measurements of anthropometric parameters (body height, body weight, skinfold thickness, body circumferences and diameters) the degree of nutritional status, body composition and somatotype were assessed. The average body height of young men was 181.46±5.53cm, while the girls were on average 166.86±5.93cm tall. The average value of the body mass index was within normal limits. Most of the respondents of both sexes was well nourished, 6.06% of girls were underweight, while 9.09% of girls and 28.09% boys had excessive body weight. At 4.49% of boys excess body weight was due to

increased fat-free mass. Overweight body mass with increased fat mass had 19.10% of boys and 6.06% girls, while the multiple increased fat mass was determined in four boys and one girl. Average fat mass was 18.01±3.57% in males and 26.68±6.03% in girls. Muscle mass accounted for an average of 42.77±7.57% of total body weight in boys and 36.76±2.99% of body weight in girls. Compared to somatotype, the majority of respondents of both sexes had a mesomorphic-endomorph type of material.

Taking into account the previous studies that treated a similar problem at the same or different populations, the problem of this research are in fact possible changes in anthropometric characteristics of students of physical education and sport in the time period 2008-2012 with the aim to determine the trend of those changes.

METHOD

The sample

The sample consists of a population of students from the Faculty of Physical Education and Sport in East Sarajevo, male, age 21± 0.5 years. The research included students from four school years (2008/09, n=45), (2009/10, n=53), (2010/11, n=40), (2011/12, n=42) for a total of 180 students.

The sample of variables

To evaluate the morphological status three variables were measured: the body height, body mass, Body Mass Index -BMI (Stolarczyk & Heyward, 1996). To obtain relevant results, by which the trend of changes of the morphological status of students, on the basis of which the responses were obtained, basic statistical procedures were applied and in terms of determining the differences the analysis was performed using the T-test for large independent samples.

Results and discussion

Table 1 Basic statistical parameters

	Body height (cm)			*Body weight (kg)*			BMI (kg/m²)		
	Mean±SD	Min	Max	Mean±SD	Min	Max	Mean±SD	Min	Max
2008/09 (n=45)	180,80±8,74	158,00	202,00	77,53±12,05	49,00	107,00	23,08±3,45	20,26	30,34
2009/10 (n=53)	180,60±8,35	158,00	195,00	76,76±13,42	49,00	106,00	24,23±7,78	21,10	31,30
2010/11 (n=40)	183,60±6,22	170,00	195,00	81,07±9,08	65,00	101,00	23,85±2,29	18,86	29,85
2011/12 (n=42)	179,30±8,23	160,00	194,00	75,38±11,58	57,00	106,00	23,41±3,11	20,28	30,31
Mean 2008-12	181,07	161,50	196,50	77,68	55,00	105,00	23,64	20,12	30,45

Legend: Mean-mean; Min-minimum score; Max-maximum score; SD-standard deviation.

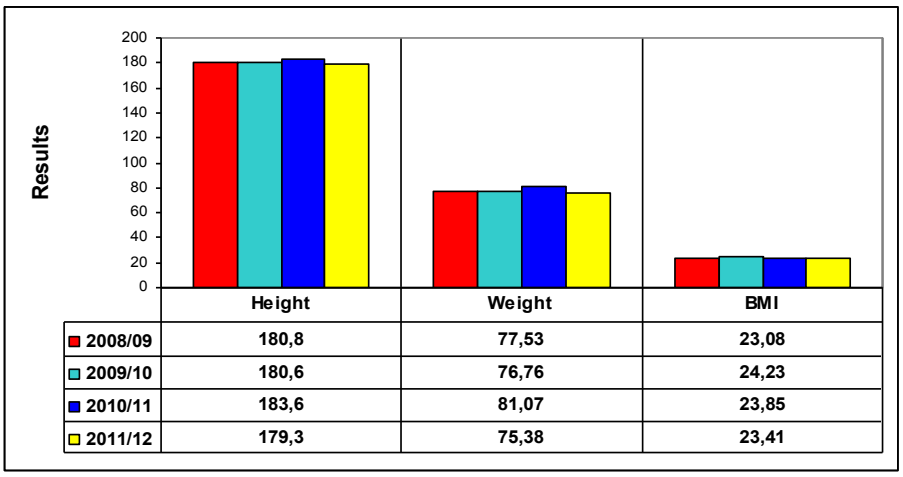
Table 2 The differences between students using the T-test

	Body height (cm)			*Body weight (kg)*			BMI (kg/m²)		
	Mean±SD	Min	Max	Mean±SD	Min	Max	Mean±SD	Min	Max
2008/09 (n=45)	180,80±8,74	158,00	202,00	77,53±12,05	49,00	107,00	23,08±3,45	20,26	30,34
2009/10 (n=53)	180,60±8,35	158,00	195,00	76,76±13,42	49,00	106,00	24,23±7,78	21,10	31,30
2010/11 (n=40)	183,60±6,22	170,00	195,00	81,07±9,08	65,00	101,00	23,85±2,29	18,86	29,85
2011/12 (n=42)	179,30±8,23	160,00	194,00	75,38±11,58	57,00	106,00	23,41±3,11	20,28	30,31
T-test **(p<0.01)	2,70**			3,55**			1,98**		

Legend: Mean-mean; Min-minimum score; Max-maximum score; SD-standard deviation; T- test (p <0.01**) - the level of significance

In Table 1 there are basic statistical parameters of anthropometric measures of researched sample of students in the period from 2008 to 2012. For each variable relevant central and dispersion parameters were calculated. After examining the values of means and standard deviations of all measures, there is considerable heterogeneity of anthropometric measures, both in one and in different generations of students. Differences do exist and are mostly related to all three measures of the morphological status. When it comes to body height, it can be seen that the generation of 2008 / 09 is the least homogeneous, where SD=8.74 cm, in body mass generation of 2009/10., SD=13.42kg and BMI values, SD=7.78kg/m². The most homogeneous generation of students by body height is the class of 2010/11, SD=6.22cm. Also this generation showed homogeneity in body weight, SD=9.08kg and BMI values, SD=2.29kg/m, so, it can be concluded that this generation was the best selected in terms of anthropometric indicators of

enrollment in college. In the second place, there comes the generation of 2011/12. because they also had the smallest variation in body height (SD=8.23cm), body weight (SD=11.58kg) and BMI values (SD=3.11kg/m), while students of 2008/09 and 2009/10 showed slightly less homogeneity in the same morphological measures.



	Height	Weight	BMI
2008/09	180,8	77,53	23,08
2009/10	180,6	76,76	24,23
2010/11	183,6	81,07	23,85
2011/12	179,3	75,38	23,41

Figure 1 *Mean values of anthropometric measures for school years*

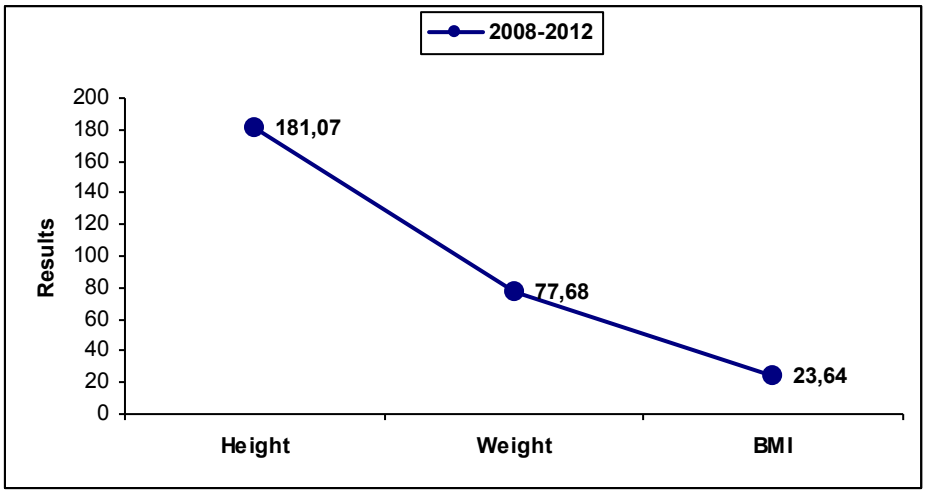


Figure 2 Mean anthropometric measures students (2008.-2012.)

To show any quantitative differences in morphological status of students, basic statistical measures were shown and analyzed by T-test for large independent samples on the level of significance ($p<0,01$). By applying T-test statistically significant differences were obtained in all measures of the morphological status (Table 2). The four generations of students who have represented a four-year period from 2008.–2012 achieved statistically significant differences. Analyzing the differences in body mass (AMAS) statistically significant difference was obtained between students in the 2008-2012 period (t=3.55**).

The highest body weight had a generation of students 2010/11. (Mean=81.07±9.08kg) in the range between the minimum and maximum score of 36kg. Slightly lower average of body mass was defining the generation of 2008/09th (Mean=77.53±12.05kg) in the range of 58kg, the generation of 2009/10 where the mean body mass was 76.76±13.42kg, and the generation of 2011/12 the values of the body mass of 75.38±11.58kg and a range of 49-57kg. Based on these values, it can be concluded that the generation of students of physical education and sport 2010/11 was the most homogeneous in terms of body mass.

Also in terms of body height were achieved statistically significant differences between students in the period since 2008. - 2012 (t=2.70**). Generation of students 2010/11 has shown the best homogeneity with a mean value (Mean=183.60±6.22cm) and a range of 25 cm. The other three

generations (2008/09; 2009/10 and 2011/12) are characterized by considerable heterogeneity of body height with range of results from 35-44 cm.

The same observation can be made for the mean BMI values which are representative of body-mass index kg/m where there are also observed a statistically significant differences(t=1.98**). The best homogeneity was defined by students 2010/11 with a mean BMI (Mean=23.85±2.29 kg/m) ranged from below the limit to 18.86 to 29.85kg/m². The greatest value of BMI was observed in the generation of 2009/10 with a mean value (Mean=24.23±7.78kg/m²) which also represents the highest BMI of all generations, with a minimum score BMI=21.10kg/m² and maximum BMI=31.30kg/m². Generations of 2008/09 and 2011/12 had approximate homogeneity in terms of the mean value (23.08kg/m²-23.41kg/m²) with a range of BMI of about 10 kg/m². Based on the analysis of the cumulative mean values of four generations of students 2008-2012 (Figure 2) it can be concluded that the mean value of body height was (181.07cm), body weight (77.68kg) and body mass index (23.64kg/m²).

The existing differences in the morphological status among a generation of students are less likely the result of the weaker selection of the entrance examination and admission of students, where these parameters do not play a significant role, but there are also some other factors in the entrance examination, closely related to the realization of some motor movement structures, technical know-how in sports, school performance, etc.. But what is relevant and always in practice proves to be correct is a good selection, regardless of what population it is about, the training process that can and should be adjusted to the desired goal (Lord, 1998). Justifiability of these conclusions are confirmed by the data of WHO. In 2006 the extensive research of the World Health Organization (WHO) was conducted, which included 22 countries, including 18,152 students (male: 8,115; female: 10,037). The following values of BMI were obtained: Belgium 22.1kg/m², England 22.7kg/m², France 21.9kg/m², Germany 22.8kg/m², U.S. 24.3kg/m², Bulgaria 23.1kg/m², Greece 23.1kg/m², Italy 22.1kg/m² (Wardle et al. 2006). In another study of 203 football players in Spain at the age of 19 years, BMI amounted to 22.96±1.2kg/m (Gil et al. 2010).

If we compare the results of this study with the results of previous research it can be concluded that the students are below the U.S. average and slightly above average of some European countries. Compared with the research Dopsaj et al. (2006); Peline et al. (2009)., Budakova et al. (2012), Vadas & Balogh (2012), students of East Sarajevo had lower BMI values, indicating that they are still there in the middle of an average of the same or similar populations. The average should be lower because it is about students of physical education and sport to which the physical activity is primary. However, if we look at the differences between the generations in the range of four years, then here also can be stated negative factors related to the trend of growing and developing population that chooses to enroll in the Faculty of Physical Education and Sport, which is the representative, mostly of the population of athletes. Namely, today lifestyle is hectic, with poor and unhealthy diet, decreased or lack of movement, in one word hypokinetic lifestyle. The effects of hypokinesia are numerous, and mostly refers to diseases of the cardiovascular system, the respiratory system and the occurrence of diabetes. In addition, it can also be mentioned the uneven growth and development of an individual leading to negative trend of development of the individual and anthropometric characteristics and the physical status of the individual (body height, weight and BMI). The close relationship between health status and body mass has been known for a long time. Somatic type of man can be determined by genetic factors, diet, socio-economic conditions, age, gender, etc.., which may have the ability and give valuable information for researchers of modern societies (Cachón-Muñoz et al. 2007).

Increased BMI, WHR and RPI are just some of the indicators of disease, such as heart diseases or diabetes mellitus. Although it has become customary to present high value of these criteria in modern societies, it is surprising to see an increase of these values in athletes. For example, research Hecth Joyce (2005) found that even ¼ of American players have the second degree of obesity.

When it comes to body height in students it can be noticed the trend of minor fluctuations, with a smaller decrease in the height in school the generation of 2011/12, compared to 2008/09, where the maximum score was 202cm, while in 2011/12 that result was 194cm. In 2005, Kimura conducted the study using data from the Ministry of Education about the secular trend of faster growth of the Japanese. The obtained results showed that the height of students and the entire population in this century has increased (except in time of war) as well as the body weight to a lesser extent. Results Ekblom et al. (2009) have shown the correlation of physical inactivity (low levels of aerobic capacity) with prediction of obesity in old age. The negative correlation of insufficient activity with functional abilities confirmed

in the research Dyrstad, et al. (2005). Butler, et al. (2004) conducted a survey of 54 female students freshmen to investigate the effectiveness of diet, physical activity and weight change associated with travel from home to college for 5 months. The results showed that, although the calorie intake was much reduced, increased body weight parameters can be attributed to a significant reduction in overall physical activity.

Comparing the results of this study with the results of Kurt et al. (2011) we can conclude that the students of East Sarajevo, on average, have higher body height 181.07 cm, weight 77.68 kg and thus the greater value of BMI 23.64kg/m² compared to students of Turkey (Height=178.67cm; Weight=73.44kg, BMI=22.86kg/m²). The increased percentage of body fat values in students received Sınırkavak et al. 2004 which is an indicator of increased BMI values and decreased activity, although it is about a relatively young and healthy" population". Researches of Sorensen et al. 2005 have examined the trend of morphological changes of the female population in police, where they have found an increasing trend of the some measures of morphological status. Similar results to this study obtained Jankovic et al. (2008), although it was about a sample of students of the Police Academy, Belgrade. Changes in trend growth, body mass and BMI in students were evident but could not determine with certainty the cause of these changes, particularly in men who have had increasing weight and nutritional status in general, as opposed to girls who have shown considerable malnutrition. Research was conducted by Dopsaj et al. (2006 on a sample of 311 female students of the Police Academy, aged 19 to 24 years, with the aim of diagnosing BMI as basic measure to assess the physical status and nutritional status noteworthy. The results showed that the average BMI of the sample female students was 21.59±2.29kg/m², and the range of scores from 16.20 to 29.24kg/m². What is with the statistically significant reliability established, was that already during the study, 4.50% of the population belongs to the category of respondents with a BMI ranging from 26.38 to 29.24kg/m², or according to all current medical standards (or consensus) belongs to the category of overweight (medium degree obesity) females, or category of individuals with inadequate or professionally unacceptable physical status. What is surprising is that in the category of underweight it is 11.58% (BMI below 19.1kg/m²), and in the anorexic category thre are 1.61% of respondents of the tested female student population (BMI below 17.5kg/m²). If we take into account that it is about a well selected population for this occupational profile then these data are both unexpected and alarming, and it is necessary to look for the cause of this situation. Almost identical results to our research were obtained in research of Krsmanovic et al. In 1997 and Srdić et al. in 2009. At the same population was found only increase in the average body weight, and BMI in relation to our sample, while the body height is almost the same (Srdić et al., Body height=181.46±5.53cm).

Just previously mentioned studies have shown that the student population is in the turbulent phase of psychosomatic changes usually manifested by heterogeneity of anthropometric characteristics (in this case Body Height=179.30 to 183.60cm, Body weight=75.38 to 81.07kg, BMI=23,08 to 24.23kg/m²). Most of the heterogeneity is reflected in the values of body mass, or BMI, where in isolated cases malnutrition or increased obesity was recorded. The obtained results however, have shown favorable anthropometric profile of most students of East Sarajevo. Based on these results it can not be said with certainty what is the consequence of the established trend of increasing volume and weight (not) nourishment of students, which should be determined in future studies. However, the key to everything is exactly in the correct directed and dosed physical activity with a balanced diet, and from exogenous factors can be stated selection and a good selection of candidates for enrollment in some faculties or academies where the the physical status of and individual is primary.

Conclusion

The study was conducted on a sample of 180 students of Physical Education and Sports, male sex, chronological age 21±0.5 years, with the aim to determine the trend of changes of anthropometric characteristics, of four generations of students in the period 2008-2012. The results showed that the in students of FFVS during the four-year period, came to statistically significant trend changes confirmed by the differences and also they defined the considerable heterogeneity of the student population. The results statistically significantly explain the differences in anthropometric characteristics at the level of significance ($p<0.01$) for the height of the body (T=2.70**), body mass (T=3.55**), and body mass index (T=1.98**). Based on the obtained results, it can be safely confirmed that the process of growth and development of the student population enrolling in the Faculty of Physical Education and Sports, is heterogeneous, variable and it is the result of numerous endogenous (heritage) and exogenous factors

(living conditions, diet, physical exercise, selection enrollment, etc.). These effects are evident in the previous studies stated in this work and are mainly the consequence of the reduced physical activity, unbalanced nutrition and conditions" of modern" way of life.

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DEVELOPMENTAL CHARACTERISTICS AND NOURISHMENT IN TEN-YEAR OLD MALE ATHLETES AND NON-ATHLETS

UDC:796.42-057.874(497.11)
(Original scientific paper)

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Abstract

Physical activity of younger primary school pupils includes activity based on two classes of Physical Education a week. A small percent of pupils does some type of physical activity on regular bases. As a result, the low level of physical activity and an increased level of calorie intake lead to obesity. The research was conducted on the fourth-grade primary school pupils in Paraćin. The sample comprised 159 ten-year old pupils, 62 of whom are athletes and 97 regularly attend Physical Education classes at school. The aim of this research was to establish the differences in the development and nourishment between the pupils who do some sport and those that attend Physical Education classes on regular bases. The results have shown that the average height of the pupils who are athletes is 146,6 cm and of those who only attend PE classes is 144,8 cm. There is statistically significant difference between the two groups. The pupils who do some sport are of significantly greater height and shoulder breadth. While the pupils who do not do any sport have higher percentage of body weight, greater pelvic and hip width, greater skin fold measurements and the sum of skinfold measurements, body mass index and body fat percentage.

Key words*: developmental differences, boys, athletes*

Introduction

Physical activity of younger primary school students includes activity based on two classes of Physical Education a week. Pupils watch TV, play computer games or text friends in their free time. They rarely burn the calories they consume through free or organized physical activity. The fact that a pupil walks for 2 kilometers or more to get to school is considered a rare and interesting news by mass media. Going to school on foot was considered normal 50 or 60 years ago. In contemporary society, younger pupils are driven to school by their parents, even though the schools are 1 or 1.5 kilometers away from their homes. The lack of physical activity leads to low muscle tone, hypotrophy, adipose tissue, obesity, abnormalities of cardiovascular and other systems. Hypokinesia of modern man leads to a series of diseases starting with obesity, diabetes, cardiovascular diseases and a number of other diseases that are the consequence of malfunction of organ systems.

In order to prevent above mentioned diseases one should do physical activity from birth to late adulthood. This may be achieved through organized physical activity in schools, clubs, and recreation centers and during the regular Physical Education classes. A small number of pupils regularly attends PE classes. Low level of physical activity together with the increased calorie intake and unhealthy food lead to weight gain above optimal values for a particular height and age.

It may be stated that obesity is becoming an epidemic starting from the early childhood to the late adulthood. The largest number of obese children has been registered in the United States of America. The number of obese children, 6 and 11 years of age has increased 54% since 1960 (Ogden et al., 2002; Kim et al., 2002). It is estimated that 22 million of children in Europe are overweight and 5 million are obese. (Cali et al., 2008).

The increased number of obese children has been registered in Serbia as well (Zdravković et al., 2009). Obesity is the cause of different diseases such as: cardiovascular diseases, diabetes, breast cancer,

and a great number of other diseases. In order to prevent such diseases, especially young people should do different types of organized physical activity since birth to late adulthood.

The aim of this research is to establish the difference in anthropometric characteristics, nourishment and body fat composition in athletes 10 years of age.

Material & methods

The research comprised 159 students of primary schools in Paraćin 10 years of age (±6 months). 62 of the total number of students are athletes, 97 are non-athletes. The students had to fulfill the following criteria: they had to be healthy and able to attend PE classes and the athletes to train and compete according to their age and category.

Longitudinal skeleton measurements were measured with a Martin anthropometer (Martin metal anthropometer- GPM Swiss Made). Circular body dimensions were measured by means of measurement worksheet- GPM Swiss Made. Skinfold parameters were measured with a caliper (calipers-GPM Swiss Made). Anthropometric variables were measured according to the methodology recommended by International Biological Program (Weiner &Lourie, 1981). 13 anthropometric variables that include longitudinal and transversal skeleton dimensions, circular dimensions and body weight together with the skin fold thickness were included. The expected height was calculated by means of Walker method (Walker, 1974). Body mass index (BMI) was established by the following formula: BMI= body weight expressed in kilos/ height expressed in meters (WHO 1997). In order to establish the level of nourishment we used Body Mass Index, the sum of skin folds and fat percentage. The level of nourishment was determined by means of the values of Body Mass Index according to standardized criteria (Cole et al., 2000) and of body fat according to the skinfold of athletes (Mišigoj-Duraković, 2008, according to Buskirku, 1974).

The variables have been labelled as following: AGE, BW- body weight expressed in kilograms, BH- body height expressed in centimeters, EBH- the expected body height expressed in centimeters, BMI- Body Mass Index expressed in kilograms/ body height expressed in m², LL- leg length expressed in centimeters, AL- arm length expressed in centimeters, SW- shoulder width expressed in centimeters, PW- pelvic width expressed in centimeters, HW- hip width expressed in centimeters, ACC- average chest circumference expressed in centimeters, UAC- upper arm circumference expressed in centimeters, TC- thigh circumference expressed in centimeters, UASFT- upper arm skinfold thickness expressed in millimeters, LBSFT- back skinfold thickness expressed in millimeters, ASFT- abdominal skinfold thickness expressed in millimeters, % FAT- the percentage of fat.

Statistical data analysis was done by Statistical package 6. For each of the measured variables we have determined basic statistical parameters of descriptive statistics: mean value (MV), standard deviation (SD), and minimum (MIN) and maximum (MAX) values. In order to establish the difference between the groups we used t- test, and the level of statistical significance of the differences was 0.005.

The results

The results in the Table 1 show that the average body weight of student-athletes is 36.9±6.21 kg. The minimum and maximum values of body weight indicate a great difference in body weight between the students. We may conclude that the average body weight value of this group of students is above 95 percentiles in comparison to body height (Gerver& DE Bruin, 1996). The average body height of student-athletes is 146.6±9.68 cm, the difference between the maximum and minimum value is 59.4 cm. Heterogeneity is the result of different sports and disciplines of student-athletes. The expected height value is 181.5±6.15 cm, and the maximum and minimum values indicate that the athletes in question do different sports. The average values of leg length (82.7±6.13 cm) and arm length (62.6±3.66 cm) are in accordance with the average body height. The average value of shoulder width is 32.7±1.88 cm, pelvic width 23.2±1.52 cm and hip width 25.2,0±1.73 cm. These values are normal values for the students of that age. The value of average chest circumference is 66.0±5.09 cm. The values indicate that the average values of chest circumference are a bit lower in comparison to the half of the values of average body height. Pelvic and hip width are in accordance with the average body height values of this group of students.

Table 1 shows the values of BMI which are 17.21±1.79 kg/m². According to the average values, athlete students are of normal body weight. Judging from the maximum values, there are student-athletes who are obese. The average value of the sum of skinfolds is 29.4±13.55 mm, which is satisfying, and the average

value of fat is 23.93±9.39%, which illustrates excessive body fat percentage in the student-athlete group (Mišigoj-Duraković, 2008, according to Buskirku, 1974).

Table 1. Basic statistical parameters of anthropometric variables, body mass index, the sum of skinfolds and %fat in student-athletes 10 years of age

Variables	N	AV	MIN	MAX	SD
AGE	62	10.4	10.0	11.0	0.45
BW kg	62	36.9	24.8	51.3	6.21
BH cm	62	146.6	127.6	187.0	9.68
EBH cm	62	181.5	168.0	195.2	6.15
LL cm	62	82.7	69.0	97.3	6.13
AL cm	62	62.6	53.3	71.8	3.66
SW cm	62	32.7	28.5	36.8	1.88
PW cm	62	23.2	19.4	27.0	1.52
HW cm	62	25.2	20.5	28.7	1.73
ACC cm	62	66.0	46.8	77.0	5.09
UAC cm	62	19.7	16.0	24.7	2.05
TC cm	62	39.0	30.3	46.3	3.49
UASFT mm	62	12.0	6.0	29.2	4.17
LBSFT mm	62	7.7	4.0	25.2	3.92
ASFT mm	62	9.6	3.6	33.2	6.14
BMI kg/m^2	62	17.21	12.87	20.82	1.79
SSF mm	62	29.4	14.2	65.8	13.55
FAT %	62	23.93	12.81	65.81	9.39

Legend: **N**- Number of students; **AV**-average value; **MIN**-minimum and **MAX**-maximum value; **SD**-standard deviation.

The results of students that are non-athletes (Table 2) indicate that the average value of body weight is 39.6±10.89 kg. It should be noted that there is a great difference between maximum and minimum values, 54.3 kg. The average values of body weight of this group are in accordance to the average body height of non-athletes 10 years of age (Garver& De Bruin, 1996). The average height of this group is 144.8±7.53 cm, and it is a normal height value at this age, it is satisfying according to the percentile rank (p 60). The average value of expected height is 180.5±5.63 cm.

Table 2. Basic statistical parameters of anthropometric variables in students that are non-athletes 10 years of age

Variables	N	AV	MIN	MAX	SD
AGE	97	10.4	9.0	11.0	0.47
BW kg	97	39.6	17.0	71.3	10.89
BH cm	97	144.8	130.1	184.7	7.53
EBH cm	97	180.5	169.4	210.3	5.63
LL cm	97	81.3	60.5	96.0	4.99
AL cm	97	61.8	55.5	71.6	3.02
SW cm	97	32.3	21.3	37.0	2.80
PW cm	97	23.8	19.9	32.0	2.25
HW cm	97	25.3	20.4	31.2	2.22
ACC cm	97	68.1	42.6	88.2	8.33
UAC cm	97	20.7	15.5	35.2	3.55
TC cm	97	40.3	31.5	58.0	5.68
UASFT mm	97	13.8	3.4	37.6	7.42
LBSFT mm	97	10.2	4.0	35.4	6.83
ASFT mm	97	12.8	3.4	36.6	8.59
BMI kg/m^2	97	18.74	8.96	30.55	4.19
SSF mm	97	36.9	14.6	103.8	21.67
FAT %	97	29.15	11.60	85.41	16.70

The difference between the minimum and maximum value of the expected height is 40.9 cm which illustrates the heterogeneity of the group. The values of measured longitudinal, transversal and circular dimensions are in accordance with the body height at this age. The values of the measured skinfolds in the area of the tree-headed muscle of the upper arm, lower back and abdomen indicate that the students 10 years of age that are non-athletes according to the average values shown here have normal levels of adipose tissue. Based on the results of minimum and maximum values of skinfold thickness, we may conclude that there are students with very low and high level of adipose tissue.

The results of non-athletes 10 years of age illustrated in Table 2 indicate that the average value of BMI is 18.74±4.19 kg/m^2. These values indicate that they are overweight (Cole et al., 2000). Based on the sum of skinfolds which is 36.9±21.67 mm, we may as well classify this group as one with a satisfying amount of adipose tissue. The average value of fat in non-athletes is 29.15±16.70 %. Non-athletes belong to the group of people with excess adipose tissue.

The values of statistically significant differences of arithmetic mean of anthropometric variables of athletes and non-athletes 10 years of age are shown in Table 3. Based on an average value of body weight in athletes which is 36.9 kg and non-athletes 39.9, we may conclude that the students that are non-athletes are of greater body weight than the student-athletes, which is statistically significant. The P value here is p= 0.000.

The average height of an athlete student is 146.6 cm and of non-athletes 144.8 cm. This indicates that athlete students are of greater height than non-athletes, which is statistically significant. The P value is p= 0.02. The average values of the expected height, leg length and arm length show that there is no statistically significant difference between the athlete and non-athlete students. The average value of shoulder width of the athletes is 32.7 cm, and non-athletes 32.3 cm. Athlete students have grater average shoulder width, which is statistically significant. The P value is p= .00. The average values of pelvic and hip width are great in students who are non-athletes, which is statistically significant. The P value is (p= .00). The average values of average chest circumference, upper arm and thigh circumference in athletes are lower in comparison to those of non-athletes, which is statistically significant difference. The P value is p= .00.

Table 3. Statistically significant difference between the arithmetic mean of anthropometric variables of athletes and non-athletes 10 years of age

	ATHLETES		NON-ATHLETES			
Variables	AV	SD	AV	SD	T-test	p
AGE	10.4	0.45	10.4	0.47	0.14	0.706
BW kg	36.9	6.21	39.6	10.89	-1.77	0.000
BH cm	146.6	9.68	144.8	7.53	1.34	0.027
EBH cm	181.5	6.15	180.5	5.63	1.00	0.436
LL cm	82.7	6.13	81.3	4.99	1.50	0.069
AL cm	62.6	3.66	61.8	3.02	1.57	0.090
SW cm	32.7	1.88	32.3	2.80	0.98	0.001
PW cm	23.2	1.52	23.8	2.25	-1.91	0.001
HW cm	25.2	1.73	25.3	2.22	-0.47	0.035
ACC cm	66.0	5.09	68.1	8.33	-1.77	0.000
UAC cm	19.7	2.05	20.7	3.55	-2.01	0.000
TC cm	39.0	3.49	40.3	5.68	-1.66	0.000
UASFT mm	12.0	4.17	13.8	7.42	-1.70	0.000
LBSFT mm	7.7	3.92	10.2	6.83	-2.67	0.000
ASFT mm	9.6	6.14	12.8	8.59	-2.51	0.005
BMI kg/m^2	17.21	1.79	18.74	4.19	-2.71	0.000
SSF mm	29.4	13.55	36.9	21.67	-2.42	0.000
FAT %	23.93	9.39	29.15	16.70	-2.24	0.000

Legend: **AV**-average value; **SD**-standard deviation. **T**-test; **p**-value

According to the analysis of average values of skinfold thickness measured in the area around the three headed muscle, upper arm, lower back and abdomen we may conclude that non-athletes have

greater values of skinfolds in comparison to athlete students 10 years of age. The P value is p= .000. Statistical significance of differences between arithmetic means of BMI, the sum of skinfolds and fat % in students who are athletes and non-athletes10 years of age is shown in Table 6. The values of BMI; the sum of skinfolds and % fat of athlete students are lower than those of students who are non-athletes, which is statistically significant. The P value is p=.000.

Discussion

The importance of establishing differences in developmental characteristics and nourishment between the students who are athletes and non-athlete is reflected in the received data on effects of physical activity on the development and optimal body weight. The researches indicate that longitudinal and transversal dimensions are polygenically determined. Circular dimensions, body weight and adipose tissue are under great influence of external factors, mainly social status (Malacko et al., 2001).

Low level of physical activity which is more and more present together with excess calorie intake lead to increased number of obese people from early youth to old age in the world and in Serbia as well (Malina, 2004; Zdravković et al., 2009; Đurašković et al., 2012). The results of this research indicate that the athlete students have lower values of body weight, skinfolds and % fat, which is statistically significant. Developmental characteristics seen through height and longitudinal and transversal dimensions indicate that the student-athletes have greater height and shoulder width in comparison to the non-athletes, which is statistically significant. This may be the result of sport selection, for each sport there are some requirements concerning body height and built. Sport selection is a process which has to be carried out continually and has to be controlled, directed towards those who possess optimal health and morphological characteristics, functional, motor, cognitive and conative skills in order to achieve top results in selected sport.

The number of genetically determined characteristics together with biological age and optimal age for taking up a certain sport play an important role in sport selection. We have to stress the fact that inherited characteristics such as: height, the length of upper and lower extremities, endurance, speed, coordination are not influenced by external factors to such an extent (Matto, 1981). According to researches student athletes and non-athletes 10 years of age belong to the group of people of normal height and growth (Garver& DE Bruin, 1996; Mišigoj-Duraković, 2008; Đurašković, 2009).

According to the results of this research, students who are non-athletes have greater average chest circumference, stretched upper arm circumference, thigh circumference and skinfold thickness. The result of this is greater body weight, and thus adipose tissue, not physical activity. Low level of physical activity of non-athletes together with excess calorie intake have caused such average values of BMI that this group belongs to overweight group of people (Cole et al., 2000). According to the sum of skinfolds we may conclude that student-athletes have lower total sum of skinfolds than non-athletes, which is statistically significant.

According to the criteria (Buskirk mentions Mišigoj-Duraković, 2008) both groups have great amounts of adipose tissue with the exception of the non-athlete group which has slightly greater amount than the student-athletes. The average values of the percentage of adipose tissue are significantly greater in the students who are non-athletes than the student-athletes 10 years of age, even though they belong to the group of satisfying values according to the criterion (Mišigoj-Duraković, 2008).

Conclusion

According to the research done on the sample which comprised student-athletes and non-athletes we may conclude the following: Students 10 years of age who actively do some sport are of statistically greater average height and shoulder width, which is the result of sport selection. Students who are non-athletes are of statistically greater body weight, circular dimensions, have greater skinfold thickness, the sum of skinfolds and % of fat in comparison to the students who are non-athletes. This is the result of low level of physical activity and excessive calorie intake.

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MORPHOLOGICAL CHARACTERISTICS OF YOUNGER SCHOOL AGE GIRLS DEFFERENT PHISICAL INVOLVEMENT

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Abstract

Physical activity is of essential value for healthy and balanced developments of children and young adolescents. Regular exercise brings many benefits for physical and mental health, as well as social functioning of children. The problem of this research was examining the effects of different models of physical exercise on changes in the morphological status on young girls. The goal of the paper was to determine the morphological characteristics of girls engaged in modern dance, as well as developmental gymnastics, for at least a whole year in continuity, and compare them to the morphological characteristics of girls the same age who have never been engaged in any organized physical activity. For the realization of this goal, we have used a battery with eight anthropometric gauges which estimate the voluminosity and body mass as well as subcutaneous adipose tissue of the subjects, as the use of means of physical activity can alter these characteristics most effectively. The results of the research show a substantial statistical difference between subjects of all age categories, and in favor of the girls engaged in developmental gymnastics and modern dance. The difference reflects in a morphological status of better quality, defined by less volume, body mass and less subcutaneous adipose tissue, which leads to the conclusion that engagement in developmental gymnastics and modern dance is very desirable and advisable for proper growth and development of young girls, especially in this very receptive stage.

***Key words**: morphological characteristics, girls, modern dance, development gymnastics*

Introduction

Physical activity is crucial for healthy and balanced development of children and youth. This has a lot of benefits not only for health in general, but for social behavior of children as well. Pre-school and younger-school age is an especially sensitive period for development of motor abilities. Besides, this period is also significant for regular physical development of the whole organism and it is important not to miss the advantages it brings in formation of motor abilities' base. Thus, the choice of adequate movement activities is of a high interest (Popović, 2010).

Specific characteristics of an athlete in a certain sport's discipline represent a result of selection and influence of training. Selection is based on abilities and skills of crucial influence on sports performance. However, trainings' effects are constraint while some of characteristics and abilities are genetically determined and thereby cannot be affected by training to a large degree. Consequently, it is very important to know the equation of sports activity specification in order to recognize all factors that are decisive for success in a certain sports' discipline. On the basis of knowledge about genetics influence on their development, it can be precisely determined which characteristics and abilities can be affected by training.

Literature describes desirable model characteristics of the top athletes in the form of basic anthropometric dimensions, their interrelations, body composition components and somatotypes. Body size and body build contribute significantly to performance in many sports, particularly in aesthetic sports such as all kinds of dances, rhythmic and artistic gymnastics, aerobics, figure skating as well as ballet. These sports pose high specific demands upon the functional, energy, motor and psychological capacities of athletes; but also upon the size, body build and composition of the performers, particularly of elite level females.

Some similar researches in this area have already been done and should be mentioned here. For example, classic and modern ballet dancers have lower body mass, lower amount of adipose tissue, but also higher bone density compared with non-dancers (Van MarkenLichtenbelt, W. D. et al, 1995;Yannakoulia, et al., 2000; Cieślicka, et al. 2012, Misigoj-Duraković, 2012; Suzović&Porčić, 2012) mainly due to more intensive muscle strain during long-time training. Research of morphological characteristics of twins showed that gymnastics' training can affect body mass, shoulder width, circumference of chest, while exogenous factors do not have influence on body height and arm length. Besides, some relative data are of high importance in anthropometry, i.e. arm/leg length correlated to body height (Čuk et al., 2007). Although gymnastics is a sport involving short bouts of physical activity, young children are exposed to relatively high physical demands. So far, effects of gymnastics training on fat mass development have not been widely researched; however, elite gymnasts have been consistently portrayed as being lighter and having a decreased fat mass compared to other sporting groups and reference populations (Laing et al., 2002; Filaire and Lac, 2002; Gurd and Klentrou, 2003; Zanker et al., 2003).

In this research the effects from application of different physical activity models on changes in morphological status of younger-school aged girls were examined. The aim was to determine morphological characteristics of girls involved with modern dance as well as developmental gymnastics for at least one year continuously and to compare them with girls of the same age who were never involved with organized physical activity.

Material & methods

The sample consisted of younger-school aged girls (7-11 years of age). Based on decimal age of examinees two groups were formed (Table 1).

Table 1. Age groups of girls

age Group of respondents	Group 1 7,00-8,99	Group 2 9,00-11,00	Σ
Girls not involved with organized training	75	72	147
Girls involved with development gymnastics	79	69	148
Girls involved with modern dance	65	61	126
Σ	219	202	421

The sample of anthropometric characteristics is chosen based on twodimensional morphological model made by Bala (1980). This model is characterized by one factor that merges longitudinal and transversal dimension of skeleton, which stands for the system of bones and another one, which defines volume and body mass and subcutaneous adipose tissue. This battery of anthropometric characteristics used for evaluation of morphological characterictics consisted of the following meassurements: *for the assessment of dimensionality of skeleton:* 1. Body height (mm); *for the assessment of volume and body mass:*2. Body weight (kg), 3. Circumference of chest (chest girth)(medium) (mm), 4. Circumference of upper arm (midarm girth)(in a relaxed position) (mm) and 5. Circumference of lower arm (forearm girth) (mm) and *for the assessment of subcutaneous adipose tissue:* 6. Skinfold of upper arm (triceps skinfold) (0.2mm), 7. Skinfold of back (subscapular skinfold) (0.2mm) i 8. Abdominal skinfold (0.2mm). All of the anthropometrical meassurements were conducted in accordance with IBP standard.

Program of developmental gymnastics as well as modern dance for girls of younger-school age includes 60-90 minutes training, 2-3 times a week, which depends on the age. These trainings are conducted from September to June of the next year. During the public appearances and competition periods the number of training is often increased to five a week. The sample of this research consisted only of the girls who are involved in one of presented programs of organized exercising for at least one year continuously. For the assessment of quantitative differences of anthropometric variables' systems of

three groups of respondents multivariate analysis of variance (MANOVA) was used. For the assessment of differences between every single anthropometric characteristic for both age groups analysis of variance (ANOVA) was applied. The level of statistical significance was P=0.05. All data were analysed by SPSS 20 software.

Results

The analysis of differences in anthropometric variables of 3 groups of 7-9-year old girls is shown in Table 2. For better understanding of differences between the groups basic statistics for both groups of respondents are given. For the assessment of quantitative differences of anthropometric variables' systems of three groups of respondents multivariate analysis of variance (MANOVA) was used. Then, the analysis of variance (ANOVA) was applied to determine differences between every single anthropometric characteristic.

Table 2. Analysis of anthropometric variables of three groups of 7-9-year-old girls

VARIJABLES	Gr	AM	S	f	p	p*	
1. Body height (mm)	1	1296,94	65,77	2,31	0,09	1-2	0,71
	2	1292,23	68,03			1-3	0,17
	3	1310,97	66,26			2-3	0,14
2. Body weight (kg)	1	27,95	4,89	11,59	0,00	1-2	0,00
	2	25,63	3,89			1-3	0,81
	3	27,79	4,64			2-3	0,00
3. Circumference of chest (chest girth) (mm)	1	597,99	40,73	0,91	0,40	1-2	0,24
	2	603,29	37,23			1-3	0,30
	3	604,23	40,79			2-3	0,88
4. Circumference of upper arm (mm)	1	211,04	21,97	45,96	0,00	1-2	0,00
	2	191,02	16,59			1-3	0,00
	3	193,60	17,07			2-3	0,38
5. Circumference of lower arm (mm)	1	190,90	13,55	25,66	0,00	1-2	0,00
	2	180,64	11,96			1-3	0,00
	3	184,93	11,46			2-3	0,03
6. Skinfold of upper arm (0,2mm)	1	106,27	57,50	21,15	0,00	1-2	0,00
	2	70,83	40,32			1-3	0,01
	3	86,27	35,81			2-3	0,04
7. Skinfold of back (0,2mm)	1	76,36	31,14	18,37	0,00	1-2	0,00
	2	59,05	21,77			1-3	0,00
	3	62,47	18,77			2-3	0,39
8. Abdominal skinfold (0,2mm)	1	110,49	33,62	17,30	0,00	1-2	0,00
	2	90,99	26,93			1-3	0,00
	3	94,40	27,64			2-3	0,46
		F = 19,19	**P = 0,00**				

Gr – groups of respondents:
1) not involved with organized training
2) involved with development gymnastics
3) involved with modern dance
AM – arithmetic mean
SD – standard deviation
f – f-test of analysis of variance
p – level of statistical significance for f
p* – level of statistical significance for f between every group of respondents
F – F-test of multivariate analysis of variance
P – level of statistical significance for F

Based on multivariate analysis of variance results, statistically significant differences (on the highest level of statistical inference, i.e. P=0.00) between anthropometric variables' systems of the groups were determined. The results of analysis of variance indicate that there are differences between respondents of this age in majority of examined anthropometric variables on the level of statistical significance of

p=0.00. The exception is the variable for the assessment of the chest circumference, for which statistically significant differences between three groups of respondents were not found.

By the partial observation of every single anthropometric variable between every combination of two examined groups statistically significant differences between majority of the variables in control group and both experimental groups were found. This does not refer to body height, body weight and abovementioned circumference of chest in the case of control group and girls involved with modern dance. By the analysis of partial differences between two experimental groups statistically significant difference in body weight, body heigth, circumference of lower arm (forearm girth) and abdominal skinfold were clearly observed.

Differences between anthropometric variables of three groups of 9-11-year-old girls are given in Table 3. Results of multivariate analysis of variance pointed to statistically significant differences in anthropometric variables' systems of examined groups. The level of the statistical inference of P=0.00. The similar results were also found for the groups of younger girls. Most of variables showed also individual statistically significant differences between the groups on the highest level of statistical inference. The exception in this case is variable for the assessment of dimensionality of skeleton – body height, where no statistically significant difference between three groups of respondents was found.

Table 3. Analysis of anthropometric variables' differences of three groups of 9-11-year-old girls

VARIJABLES	Gr	AM	S	f	p	p*	
1. Body height (mm)	1	1429,1	73,09	2,12	0,12	1-2	0,12
	2	1414,9	82,44			1-3	0,08
	3	1404,9	75,93			2-3	0,47
2. Body weight (kg)	1	35,97	6,59	6,07	0,00	1-2	0,01
	2	33,88	6,62			1-3	0,00
	3	32,61	6,12			2-3	0,27
3. Circumference of chest (chest girth) (mm)	1	651,58	52,42	4,52	0,01	1-2	0,04
	2	664,46	56,36			1-3	0,17
	3	638,51	48,21			2-3	0,01
4. Circumference of upper arm (mm)	1	229,85	28,85	37,88	0,00	1-2	0,00
	2	208,83	19,74			1-3	0,00
	3	201,61	19,61			2-3	0,09
5. Circumference of lower arm (mm)	1	205,15	16,35	23,74	0,00	1-2	0,00
	2	194,34	14,69			1-3	0,00
	3	191,34	14,19			2-3	0,27
6. Skinfold of upper arm (0,2mm)	1	143,52	77,47	25,86	0,00	1-2	0,00
	2	94,08	50,85			1-3	0,00
	3	94,44	35,70			2-3	0,97
7. Skinfold of back (0,2mm)	1	90,28	41,36	19,86	0,00	1-2	0,00
	2	68,39	25,26			1-3	0,00
	3	65,56	17,55			2-3	0,62
8. Abdominal skinfold (0,2mm)	1	121,58	40,22	19,50	0,00	1-2	0,00
	2	97,05	27,66			1-3	0,01
	3	105,56	30,86			2-3	0,16
		F = 17,94	**P = 0,00**				

Partial analysis of individual anthropometric variable between every combination of two examined groups showed that there are statistically significant differences between most of variables in control and both experimental groups. Body height and circumference of chest were exceptions in this case. By the analysis of partial differences of two experimental groups, the only statistically significant difference was found for the circumference of chest variable.

Discussion

From the results of arithmetic mean for every variable in both age groups it can be seen that majority of examined variables have higher values in case of girls not involved in any kind of organized training. It

means that girls involved in developmental gymnastics and modern dance have lower values of body mass circumference of lower and upper arm and amount of subcutaneous adipose tissue in general compared with girls of the same age not involved in organized physical activity. Thus girls from both experimental groups have better quality of soft tissue. Lower values of circumference of lower and upper arm is direct consequence of lower amount of subcutaneous adipose tissue in those body segments. These results are expected while the requests for gracile morphological structure of girls are emphasized due to ease of performance of dance, acrobatic and all the other elements of choreography but also the visual experience and impression they leave on judges especially in dance. Therefore in training process correction of nutrition, decrease of body mass and subcutaneous adipose tissue in all body segments occupy a special place. This implies better status of motor abilities as well as specific morphological structure these girls have latter in life. (Van MarkenLichtenbelt, W. D. et al, 1995;Yannakoulia, et al., 2000; Laing et al., 2002; Filaire and Lac, 2002; Gurd and Klentrou, 2003; Zanker et al., 2003; Čuk at al., 2007; Kostić, Zagorc and Uzunović, 2004, Viskić-Štalec at al. 2007; Steinberg et al., 2008, Cieślicka, et al. 2012, Misigoj-Duraković, 2012; Suzović and Porčić, 2012).

Results show that there is no any statistically significant difference between the respondents of both age groups in body height. This unambiguously prove the fact that body height is not a limiting factor for successful training in developmental gymnastics and modern dance which is important for the selection in those two sport activities. However, elite gymnastics implies much lower body height and lower values of longitudinal dimensionality of skeleton. In this research the emphasis is on the population of girls involved with developmental, recreational gymnastics, adopted for every age and body constitution of girls and boys.

It is interesting to mention the absence of statistically significant differences between younger respondents in variable circumference of chest, where higher values had girls from experimental groups while in the case of older group those values for girls involved with developmental gymnastics where significantly higher than in other two groups. This fact as well as the above mentioned skinfold brings the conclusion that circumference of chest in group of girls involved with developmental gymnastics has higher values due to muscle mass. It is expected concerning the fact that training in gymnastics consists of learning and exercises of gymnastic elements and combinations on different apparatus in many arm-stand positions, specific hang positions etc. Which include hypertrophy of muscles and thereby the increase of volume especially in the chest area. The same conclusion was presented by (Madić, Mikalački and Popović, 2008; Madić, Popović and Kaličanin, 2009; Popović, 2010).

Analysis of differences in anthropometric variables of two experimental groups showed lower values of all of the examined characteristics in younger group. However some of these differences are not statistically significant. Girls involved in developmental gymnastics are shorter, weight less and have lower volume and amount of subcutaneous adipose tissue in comparison with girls of the same age involved with modern dance. This type of body structure originates from specific requests of training in those two groups. Namely, modern dance for younger girls emphasizes adoption of basic ballet technique which is usually static, learning of simple combination of dancing elements and less demanding jumps, basic spin technique etc. All these elements are performed in gently movement so the training is of mild intensity. Unlike modern dance, in developmental and especially elite gymnastics the intensity of training is high from the very beginning and this includes general physical preparedness, large number of repetition of exercises, jumps, vaults etc. Thus, specific morphological status of girls involved in developmental gymnastics is formed in the youngest age.

However, beside abovementioned variables for the assessment of circumference of chest, in older group there are no other statistically significant differences between two experimental groups. It can be explained by the increase of training's intensity for older dancers. Duration of training is changed from 60-90 minutes and fourth training a week is often included especially for soloists and requests are far more serious than in younger age. This unambiguously implies the formation of specific morphological structure of dancers that is similar to the one for girls involved in developmental gymnastics.

Conclusions

It can be concluded that the program of developmental gymnastics and modern dance had influence on morphological status of younger school-aged girls especially on characteristics that define volume and body mass and subcutaneous adipose tissue. Comparative analysis of morphological characteristics of girls involved in developmental gymnastics and modern dance and characteristics of girls not involved in

any kind of organized training showed statistically significant difference in quality of morphological status defined by lower volume, body mass and subcutaneous adipose tissue. This points to which morphological type of younger-school aged girls is the most suitable for successful training in developmental gymnastics and modern dance. These results confirm the results of other authors that emphasized the significance and advantages of organized physical activities (dancing and gymnastics in the first place) for better morphological characteristics of pre-school and younger-school aged children (Blažević, Katić and Zagorac, 2002; Laing et al., 2002; Filaire and Lac, 2002; Gurd and Klentrou, 2003; Madić, Mikalački, Popović, 2008; Madić, Popović, Kaličanin, 2009; Popović, 2010; Uzunović, Kostić and Živković, 2010). These programs are recommended for better quality of morphological characteristics of children but also for all the other anthropological dimensions of pre-school and younger-school aged children.

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DIFFERENCES BETWEEN APPLIED MOTOR VARIABLES AT THE INITIAL AND FINAL MEASUREMENT IN BASKETBALL PLAYERS FROM 16 AND 17 YEARS OF AGE

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(Original scientific paper)

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Abstract

A sample with 108 participants was composed of 16 and 17 year old female basketball players, members of the youth schools of FBC "Struga 2009", FBC "Krosig" Skopje, and FBC"Bashkimi" Prizren, to determine the effects of sixteen-week practice process for developing explosive strength of the lower limbs. The sample was composed of three groups, comprised of 36 female basketball players. The research applied a total of six (6) variables for the assessment of the general motor skills: Standing long jump /SLJ/, Vertical jump – Sargent test/SART/, Running 20 m from high start /R20MHS/, Test of agility 4x10m/AGT/, T-Test /TT/, and Zig-zag movement in racket/ZZMR/. Based on the results obtained we came to a conclusion that both experimental models applied improved explosive power of the lower limbs. The first experimental model causes significant positive changes and is more efficient than the second one. Both models can be realized by 16 and 17 year old female basketball players. The survey has a theoretical and practical importance especially in the area of program applications, sport and sport science.

Key words: *experimental program, explosive power, univariate, variance, regressive analysis, motor abilities.*

Introduction

The main purpose of this research is to find the important elements for achieving success in basketball. Physical preparation (explosive power of lower extremities) of the basketball players in the final decade is becoming more and more important as the contemporary basketball game requires maximal prepared players. There has been made an effort through testing of some motor characteristics in 3 female teams in order to get relevant data about the success in basketball. The methods of explosive power development (plyometric - isometric) have been successfully adopted for many years in the technology of sport preparation in all types of sport. Such trainings, despite the fact that affect the muscle quality, also increase the importance of the results of the main skills, such as muscle stiffness. In this research it is noticed that the young basketball players, when under the influence of the programmed training process, usually achieve better results in the final measurement rather than in the initial one. This research gives answer to the following questions and dilemmas: where should the plyometric training be placed in the training programme, which exercises are more efficient for basketball players, how long it is necessary to train, with what workload intensity and in which period of training process should the analysed experimental program be applied.

Material & methods

The examinees were young basketball players aged 16 and 17, who had been trained at least 4 years. The examinees in question are members of the following young schools of basketball clubs: "FBC Struga 2009" from Struga, "FBC Krosig" from Skopje, "FBC Bashkimi" from Prizren. This model of research in total includes 108 examinees who were divided in 3 sub-models, with 36 examinees in each of them. The first experimental group E-1 realized 16 week-experimental program for improvement of the explosive power of lower extremities with plyometric training in FBC "Struga 2009" from Struga. The second experimental group E-2 realized 16-week experimental program for improvement of the explosive power of lower extremities with exercises of general character for development of the explosive power called

"Chess table" in FBC "Krosig" from Skopje. Control group K-1 realized technical-tactical elements as provided by the trainer program of the club FBC "Bashkimi" from Prizren. During this research there were two measurements executed: initial and final measurement. In the research in question there were applied in total 6 variables for assessing the general motor space: Standing long jump /SLJ/, Vertical jump – Sargent test /SART/, Running in 20 metres from high start /R20HS/, Agility test 4 x 10 m /AT4x10/, T-Test /TT/ and Zig-zag movement in racket /ZZMR/.

Results and discussion

In Table No.1 there are presented results of T-test for motor variables between initial and final measurement at the first sub-model examinees. From the table analysis it is easily noticed that there have been confirmed big statistical differences in arithmetic means of initial and final measurement in all of the studied variables, and the examinees achieved better results in the final measurement. This means that the applied experimental program (the applied experimental model) for this sub-model significantly contributed in the improvement of general motor skills, respectively, explosive power of the lower extremities. The highest percentage increase of the final measurement, as expected, was achieved at the variables SLJ (16.4%) and SART (13%), because in the applied experimental model there was given special emphasis to the exercises for development of the explosive power of the lower extremities. If we look at the remained results, we can easily notice that at the variables left, in which the results are measured with seconds, the time is improved from 7 - 9%. The obtained results are satisfactory enough if we take into account the fact that the experimental program was realized in a period of 4 months.

Table 1. T-test for motor variables between initial and final measurement at the first sub-model examinees

Variables	Mean	Mean				Growth	Std.Dev.	Std.Dev.
	G – 1	G - 2	t-value	df	P	in %	G – 1	G – 2
SLJ	153.033	178.166	-6.145	70	.000000	16.4	16.04193	15.63833
SART	31.6000	35.7333	-3.530	70	.000822	13.0	4.31197	4.74838
R20MHS	4.2377	3.8967	5.642	70	.000001	-8.04	.21720	.24979
AGT4X10	11.6793	10.5827	6.831	70	.000000	-9.38	.59038	.65175
T-TEST	11.2730	10.4743	4.788	70	.000012	-7.08	.66020	.63166
ZZMR	7.5707	6.9733	7.316	70	.000000	-7.89	.30060	.33108

The results from T-test related to motor variables between initial and final measurement at the second sub-model examined group are presented in table no.2. In the table it is noticed that there is confirmed statistically significant difference between arithmetic means of initial and final measurement in all applied variables. From all the variables studied, examinees achieved better results in the final measurement. This means that the applied experimental program (the applied experimental model) for this sub-model significantly contributed to the improvement of general motor skills, respectively, the explosive power of the lower extremities. In contrast to the first one, the percentage increase in this sub-model, although being significant, is lower in all the variables in question. Highest percentage increase is noticed at the following variables: SLJ (9.5%) and SART (9.8%). However, it may be freely said that even this second experimental model gives good results, improves the explosive power of the lower extremities, but with a lower percentage increase when compared to the first experimental model. The reasons for the differences between values may be searched even in the different morphological characteristics and motor skills at the examinees. At the remaining variables the values of the achieved results of the final measurement are higher than 4 - 6 % , with regard to the results of the initial measurement.

Table no.2. T-test for motor variables between initial and final measurement at the second sub-model examinees

Variables	Mean	Mean				Growth in	Std.Dev.	Std.Dev.
	G – 1	G - 2	t-value	Df	P	%	G – 1	G – 2
SLJ	157.23	172.20	-4.757	70	**.000013**	9,52	11.781	12.573
SART	32.300	35.466	-2.882	70	**.005520**	9,82	4.3719	4.1334
R20MHS	4.1663	3.9843	3.2166	70	**.002123**	-4,37	.20767	.23003
AGT4X10	11.651	11.067	4.0313	70	**.000164**	-5.01	.51042	.60749
T-TEST	12.245	11.469	5.1340	70	**.000003**	-6,33	.55033	.61801
ZZMR	7.5807	7.1347	4.7596	70	**.000013**	-5,87	.38566	.33865

The results of T-test for motor variables of initial and final measurement at the third sub-model examinees are presented in table no.3. From the table analysis one may easily notice that there is no any statistically significant difference between arithmetic means of initial and final measurement in all the variables studied. The percentage increase in motor variables in this sub-model is minimal and it moves around the limits of 1.9% for SLJ up to 3.9% for SART. The said experiment lasted 4 months and during this period it was noticed a minimal move of the motor skills of the examinees. This shows the need for application of one of the proposed experimental models.

Table 3. T-test for motor variables between initial and final measurement at the third sub-model examinees

Variables	Mean	Mean				Growth	Std.Dev.	Std.Dev.
	G - 1	G - 2	t-value	Df	P	in %	G - 1	G - 2
SLJ	155.96	159.03	-.8940	70	.375036	1.96	13.41765	13.152
SART	29.866	31.033	-1.411	70	.163464	3.90	3.03694	3.3577
R20MHS	4.2623	4.1980	1.3015	70	.198245	-1.50	.19769	.18500
AGT4X10	11.998	11.854	.8124	70	.419909	-1.20	.69429	.67547
T-TEST	11.729	11.590	.7903	70	.432551	-1.18	.71115	.65662
ZZMR	8.3653	8.2227	.6251	70	.534372	-1.70	.93147	.83376

Conclusions

This research was conducted in order to confirm the effect resulting from the application of two experimental models for the development of explosive power of the lower extremities, lasting 16 weeks. The obtained values of the t-test related to motor variables in the first and second sub-model examinees show that there exists a statistically significant effect in all variables studied so far. Based on the obtained results we may conclude that both applied experimental models do improve the explosive power of the lower extremities. The first experimental model causes more significant positive changes and is more efficient when compared to the second experimental model. The increase of the results at the examinees of the first sub-model is significantly higher when compared to the second and third sub-model. Both models can be applied at the basketball players of 16 and 17 years of age.

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ANTHROPOMETRIC AND MOTORIC DIFFERENCES BETWEEN BOYS AND GIRLS AGED 14-15 YEARS UNDER THE INFLUENCE OF PHYSICAL EDUCATION PROGRAMME

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(Original scientific paper)

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Abstract

57 pupils, aged 14-15 years, 22 girls and 35 boys were involved in this study. The aim of the study was to verify if there are differences between girls and boys in anthropometric and motor parameters, as well as to determine the impact of the physical education program in improving motor skills or not, within a school year, with two hours per week, as it was approved by the Kosovo Ministry of Education. Besides the program of physical education with two hours per week, additional hours are included in the athletics competitions: short and medium length running, competition on three sports games: Football, Basketball and Volleyball; five days swimming, and five day skiing within the regular school year. Both measurements were performed on eight variables: two of them were anthropometric and six of them motor variables: height, weight, sit and rich test, push-ups, standing long jump, sit ups, back extension and running in 60 meters. Initial measurements were made at the beginning of the school year. All variables were compared with the final measurements at the end of the school year to the same variables. Trough Canonical discriminant analyses were proved that there were positive changes in favor of the final measurements of motor skills in both sexes as a result of the physical education program. There were also differences between girls and boys in both measurements, except for body weight and flexibility in which variables do not have any important changes.

Key words: *program, physical education, influence, positive change.*

Introduction

Programming and controlling the transformative process in physical education is of special importance and remains a challenge for teachers, pedagogues and trainers of physical education and sports in general. Physical education programme in elementary and secondary schools consists of two classes per week approved by the Ministry of Education, Science and Technology of the Republic of Kosovo. This study is focused on validating the influence of physical education programme in improvement or not of motoric abilities during a calendar year. In addition, it looked into validation of anthropometric changes and motoric abilities between males and females. Morphological changes during the second decade of life are dramatic, and the period pertains to beginning of adolescence, which lasts from 3 to 5 years on average. Puberty is the period of time when males and females start to develop their physical characteristics of an adult male and female. Females reach their peak growth between 10 and 13, while males between 12 and 15. Both females and males may reveal a strong wave of physical energies during this period of time.

Material & methods

A sample of 57 14-15 year-old students, 22 females and 35 males, all full-time students at "Aga Xhite" private college in Ferizaj, Kosovo, are included in the study. Two measurements were administered along 8 variables – two anthropometric and six motoric ones, including: height (H), weight (W), sit and rich test (SRT), push-ups (PUPS), standing long jump (SLJ), sit ups (SUPS), back extension (BEXT) and 60-meter run (R60m). Initial measurements from the beginning of the school year 2003, were compared to final measurements of the same variables administered in June 2004. Based on results of the parameters, the following statistics are presented: mean (X), standard deviation (SD), Kolmogorov-Smirnov test for normal distribution of the results known as MaxD, while for the differences between

initial and final measurements, as well as for differences between males and females, the Discriminant Canonical Analysis for SPSS package was used. Symbols: (F) Females, (M) Males, (1) first measurements, (2) second measurements.

Results and Discussion

Results from basic statistical parameters with regard to both initial measurements and final measurements for both male and female groups indicate that the data followed normal distribution as per MaxD values and test values in following tables 1 and 2, where all MaxD values of Kolmogorov-Smirnov test are lower that test values: for the female group (Test) = .347) and for the male group (test) = .275. Contrary to normal distribution of results from initial measurements at the beginning of the school year in September 2003, results showed that for final measurements of June 2004 the distribution of results was more compact. The mean for standing long Jump for girls (Mean) = 147.27cm and for boys (Mean) = 189.60cm of the initial measurements of this research was compared to the mean of standing long jump of girls with (Mean) = 138.28cm and of boys (Mean) = 181.54 of the research conducted by Gontarev S, Zivkovic V, Naumovski M, Kalac R, (2013), considering the sample size included in research.

Table 1. Basic statistical parameters

Female						
Initial measurement				Finale measurement		
Variable	Mean	SD	MaxD	Mean	SD	MaxD
H	1609.64	59.70	0.15	1620.45	58.61	0.11
W	56.91	10.56	0.13	59.27	10.86	0.16
SRT	42.77	8.29	0.13	45.32	7.80	0.14
PUPS	3.73	4.00	0.08	7.82	5.31	0.15
SLJ	147.27	23.76	0.10	152.32	22.76	0.23
SUPS	17.59	10.81	0.15	37.18	14.43	0.14
BEXT	19.32	13.60	0.17	38.18	13.95	0.15
R60m	11.86	1.88	0.16	10.85	1.07	0.18

Test .347

Symbols: Height (H), weight (W), sit and rich test (SRT), push-ups (PUPS), standing long jump (SLJ), sit ups (SUPS), back extension (BEXT)and running in 60 meters (R60m).

Table 2. Basic statistical parameters

Male						
Initial measurement				Finale measurement		
Variable	Mean	SD	MaxD	Mean	SD	MaxD
H	1704.26	85.72	0.15	1735.86	76.52	0.07
W	60.03	11.72	0.13	65.06	11.14	0.10
SRT	42.57	8.23	0.13	44.29	8.89	0.09
PUPS	13.66	7.22	0.08	20.40	7.80	0.16
SLJ	189.60	20.55	0.10	206.89	19.12	0.08
SUPS	33.34	16.97	0.15	59.29	36.83	0.24
BEXT	46.46	20.44	0.17	55.69	19.15	0.24
R60m	9.22	0.78	0.16	8.63	0.60	0.08

Test .275

For changes between initial and final measurements among girl sample see Table 3. For changes in boys' sample, see Table 4. We have utilized discriminant canonical analysis and T-test for dependant groups. From obtained results, we can state that there were positive changes in favour of final measurements under the influence of physical education programme during a school year. The justification for this is the following: students had not had prior basic information with regard to movement techniques in certain sports; they lacked information on running techniques, timely reaction,

acceleration, positioning of feet during running and at finish. In addition, criteria set by the physical education teacher in tests for assessing motor abilities, criteria they had to meet to get a positive grade, mobilized students to improve their motor skills. Competitions organized in sports mentioned above have also affected the increased positive competition between different classrooms, thus affecting positively students' motor abilities as well. None of the 57 tested students in the sample could not swim or ski, while after the five day training of swimming and skiing, students obtained at least two swimming techniques: free style and frog style, and at least three skiing techniques: diagonal skiing, snowplow and parallel turn. Curriculum of physical education course was implemented fully at 100% and it was closely monitored by the respective school management.

Table 3 T-Test for dependent group Female and Male

Female

t-Test for dependent group Female					
Variable	Mean	SD	Diff.	T	sig
H1	1609.64	59.70	-10.82	-7.54	0.00
H2	1620.45	58.61			
W1	56.91	10.56	-2.36	-4.54	0.00
W2	59.27	10.86			
SRT1	42.77	8.29	-2.55	-2.10	0.00
SRT2	45.32	7.80			
PUPS1	3.73	4.00	-4.09	-3.83	0.04
PUPS2	7.82	5.31			
SLJ1	147.27	23.76	-5.05	-1.78	0.00
SLJ2	152.32	22.76			
SUPS1	17.59	10.81	-19.59	-9.30	0.00
SUPS2	37.18	14.43			
BEXT1	19.32	13.60	-18.86	-6.82	0.01
BEXT2	38.18	13.95			
R60m1	11.86	1.88	1.00	3.74	0.00
R60m2	10.85	1.07			

Male

t-Test for dependent group Male					
Variable	Mean	SD	Diff.	T	Sig
H1	1704.26	85.72	-31.60	-8.80	0.00
H2	1735.86	76.52			
W1	60.03	11.72	-5.03	-7.44	0.00
W2	65.06	11.14			
SRT1	42.57	8.23	-1.71	-1.81	0.08
SRT2	44.29	8.89			
PUPS1	13.66	7.22	-6.74	-10.68	0.00
PUPS2	20.40	7.80			
SLJ1	189.60	20.55	-17.29	-7.40	0.00
SLJ2	206.89	19.12			
SUPS1	33.34	16.97	-25.94	-5.69	0.00
SUPS2	59.29	36.83			
BEXT1	46.46	20.44	-9.23	-3.92	0.00
BEXT2	55.69	19.15			
R60m1	9.22	0.78	0.58	6.50	0.00
R60m2	8.63	0.60			

Symbols: (1) First measurements, (2) second measurements, height (H), weight (W), sit and rich test (SRT), push-ups (PUPS), standing long jump (SLJ), sit ups (SUPS), back extension (BEXT)and running in 60 meters (R60m).

Table 4 .T-Test for independent group Female and Male

INITIAL MESUREMENT					
Variable	Mean	SD	Diff.	T-value	Sig.
FH	1609.64	59.7	94.62	-4.906	0.00
MH	1704.26	85.72			
FW	56.91	10.56	-3.12	-1.04	0.30
MW	60.03	11.72			
FSRT	42.77	8.29	-0.2	0.09	0.92
MSRT	42.57	8.23			
FPUPS	3.73	4	-9.93	-6.666	0.00
MPUPS	13.66	7.22			
FSLJ	147.27	23.76	-42.33	-6.892	0.00
MSLJ	189.6	20.55			
FSUPS	17.59	10.81	-15.75	-4.282	0.00
MSUPS	33.34	16.97			
FBEXT	19.32	13.6	-27.14	-6.018	0.00
MBEXT	46.46	20.44			
FR60m	11.86	1.88	2.645	6.273	0.00
MR60m	9.22	0.78			

FINAL MESUREMENT					
variable	Mean	SD	Diff.	T-value	Sig.
FH	1620.45	58.61	-115.4	-6.417	0.00
MH	1735.86	76.52			
FW	59.27	10.86	-5.78	-1.938	0.05
MW	65.06	11.14			
FSRT	45.32	7.8	1.03	0.46	0.64
MSRT	44.29	8.89			
FPUPS	7.82	5.31	-12.58	-7.244	0.00
MPUPS	20.4	7.8			
FSLJ	152.32	22.76	-54.57	-9.361	0.00
MSLJ	206.89	19.12			
FSUPS	37.18	14.43	-22.1	-3.183	0.00
MSUPS	59.29	36.83			
FBEXT	38.18	13.95	-17.5	-3.982	0.00
MBEXT	55.69	19.15			
FR60m	10.85	1.07	2.22	8.856	0.00
MR60m	8.63	0.6			

Symbols: Female (F), male (M), Height (H), weight (W), sit and rich test (SRT), push-ups (PUPS), standing long jump (SLJ), sit ups (SUPS), back extension (BEXT)and running in 60 meters (R60m).

To see differences in anthropometric and motor abilities between female and males we used the discriminant canonical analysis, i.e. T-test for independent groups. Differences between females and males were evident in initial and final measurements in all applied tests, with exclusion of the variables on Weight and Flexibility, in which there were no differences either in initial or final measurements. A plausible explanation for this could be the fact that 14-15 age group for boys is still an early phase to add weight which would differentiate them from girls, but as a result of this, flexibility abilities of boys in the sample were not statistically significant different from girls.

Conclusions

The study was focused in validating the influence of physical education programme in improvement or not of motor abilities during a school year. The study also focused on validating differences in anthropometric and motor abilities between females and males for a 14-15 year-old sample, which is an age that pertains to puberty period and it is featured with dramatic anthropometric and motor changes. The results of the study indicated that there were positive changes in both genders in favour of final measurements as a result of the physical education programme during the regular school year. In addition, other curricular activities were organized, including training on swimming, skiing, sport competitions, which are envisioned by the school curriculum and implemented based on opportunities provided by the school. Also, gender differences between females and males for the 14-15 age groups were evident in both measurements, excluding two variables on weight and flexibility, where there were no statistically significant differences. The role of physical education pedagogue in implementing the curriculum, commitment to student achievement of skills, economic and infrastructure conditions at the school, are all important factors in children's wellbeing with regard to improvement of their psychosomatic status, and extending active time doing sport and recreation activities also serve well to students' health, and in this aspect, the Ministry of Education, Science and Technology could give its contribution by increasing the number of classes for physical education from two to three hours per week.

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DIFFERENCES IN SOME MORPHOLOGICAL CHARACTERISTICS BETWEEN STUDENTS OF FACULTY OF ECONOMICS AND FACULTY OF KINESIOLOGY IN SPLIT

UDC:796.012.1-057.875(497.5)
(Original scientific paper)

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Abstract

The aim of this research was to evaluate the morphological characteristics of female students of Faculty of Kinesiology, and to ascertain possible differences between the mentioned population of students and the students of other study groups, in the area of morphological characteristics.With this aim, a group of 20 morphological measures was applied on the sample of 115 female students of first and second year of Faculty of Economics at the University of Split, and the mentioned measures were used to determine the somatotype, according to the Heath-Carter method, while the body mass index and subcutaneous fat tissue percentage were calculated as well. The factor analysis of morphological variables isolated four latent dimensions, in both groups of examinees likewise. The results of variance analysis and discriminant analysis showed that the students of Faculty of Kinesiology had lower amount of subcutaneous fat tissue, expressed in percentage (%), especially in the area of lower leg, thigh and upper arm. Also, the students of Faculty of Kinesiology differed from the students of Faculty of Economics in higher voluminosity values (thigh, lower leg and upper arm volume). According to the body type (somatotype), the endomorph component was more expressed in the students of Faculty of Economics, in relation to mesomorph component, compared to the students of Faculty of Kinesiology. Based on the obtained results, it is possible to conclude that the bodily activity during college significantly influences the morphological characteristics of students who study at the Faculty of Kinesiology, while the bodily inactivity, especially sedentary lifestyle favor the occurrence of increased values of subcutaneous fat tissue and the decrease of muscle mass.

***Key Words**: morphological characteristics, female students, fat tissue, somatotype*

Introduction

The lifestyle of every individual greatly influences one`s morphological characteristics. Unfortunately, sedentary life is common today, characterized by the decrease of necessity for movement, increased input of calories and greater exposure to stress. The consequences of such lifestyle are primarily the increase of cardio-vascular diseases, diabetes and some types of carcinoma. The cause for the increase of number of people inflicted by these diseases is primarily excessive body weight in all age groups (Vieno, 2005). This is caused by the increased input of calories, especially fats and carbohydrates and the insufficient usage of calories because of the decreased need for movement (Periskova, 1996). The difference between the consumed and used calories is stored in body fat cells. The result analysis of morphological characteristics of female students of two faculties can show us the possible changes, when compared to previous researches (Mišigoj-Duraković et al., 1998).

During growth and development the condition changes under the influence of genetic and social factors. The high quality conditions of life influence faster growth, in which the average body height in adult age increases, compared to previous generations, the so called phenomenon of "biological acceleration" or, the secular trend. The secular trend is the phenomenon of increase of body height and mass in children and young people and their faster maturation, compared to previous generations of same age. According to M. Mišigoj-Duraković, 2008, the causes of secular trend are in

better life and habitation conditions, vaccination, urbanization, medical advances, increase of food availability, increase of population mobility, reduction of family size and other.

While during the evolution of man the height measures were significantly lower, today, besides the characteristic of higher height values, we also find the problem of higher values of body mass that is unfortunately not caused by powerful musculature, but due to hypokinesia in great number of young people it is caused by the so-called ballast mass (or, subcutaneous fat tissue).

The morphological characteristics, whose evaluation was based on the anthropologic measures, are subject to changes during growth and development and are influenced by different endogenous (genetic and endocrine) and exogenous factors (nutritive, sociologic, economic, geographic, climate influences and the level of bodily activity). The changes of morphologic characteristics during growth and development, the processes of biologic acceleration and the diseases of modern society such as obesity emphasize the need of systematic observance. The model of latent morphologic characteristics was defined based on the results of numerous researches during the seventies and was defined by four latent dimensions: longitudinal skeleton dimensionality, transversal skeleton dimensionality, body volume and mass, fat tissue (Momirović et al., Kurelić et al.).

The determination of the differences between the examinees with increase amount of bodily activity and the examinees with lower amount of kinesiological activity can serve as further guideline, in changing or introducing new contents in classes of Physical Culture at colleges. The aim of this research was to determine the differences in morphological characteristics between two groups of female students at different universities.

Research methods

The sample of examinees consisted of two groups of female students. The first group consisted of 60 first and second year students of Faculty of Economics in Split, second group consisted of 55 female students of Faculty of Kinesiology in Split. The age of students was 18-20 years.

Sample of variables

Twenty-one morphologic measures were measured on the sample: measures for longitudinal dimensionality, transversal dimensionality, body volume and mass and subcutaneous fat tissue.

For the longitudinal skeleton dimensionality: AHEI- body height, ALL- leg length, AAL- arm length, ABIACRO- biacromial span, AFL- foot length.

For body volume: ABW- body weight, ATHOV- thorax volume, AUPAV-EXT- upper arm volume in extension, ATHV- thigh volume, AABV-1- abdominal volume, ALOWLV-FLE- lower leg volume in flexion. For subcutaneous fat tissue: AUPASF- upper arm skin fold, ABACSF- back skin fold, AABSF-1- abdominal skin fold, ATHSF- thigh skin fold, ALOWLSF- lower leg skin fold, ASUPILSF- suprailiocristal skin fold. For the transversal skeleton dimensionality: AFOOTW- foot width, AELBDIA – elbow diameter, AWRIDIA – wrist diameter, AKNEDIA – knee diameter.

The somatotype was determined using the listed measures, according to Heath-Carter method, the body mass index has been calculated, as well as the percentage of subcutaneous fat tissue.

Data processing methods

The STATISTICA 11. Software was used in data processing. In data processing method we used descriptive statistics, factor analysis, univariate variance analysis and discriminative analysis.

Results

The results of descriptive parameters of anthropometric measures for female students of Faculty of Economics , and the parameters of female students of Faculty of Kinesiology are presented in table 1.

Arithmetic mean, standard deviation, minimum and maximum result, were calculated. All the variables had normal distribution. The detailed inspection of the descriptive parameters of the morphological measures showed that the female students of the Faculty of Economics had higher values of subcutaneous fat tissue. Comparison of these results for the female students of Faculty of Economics with the examinees from the research (Caput, 2007) showed that the examinees of this research were 3 kg heavier and 4 cm taller, and they also had more subcutaneous fat tissue on the upper arm. This information is interesting since it indicates the specific characteristics of this geographical area (alimentary habits, climate, Dinarid type etc.).

Table 1, Basic descriptive parameters

Variable	AM (FE)	MIN	MAX	SD	AM(FK)	MIN	MAX	SD
AHEI	170,15	153,00	185,00	5,64	170,11	157,00	183,50	5,48
ALL	96,55	87,00	107,00	3,80	95,36	85,50	103,30	4,18
AAL	73,30	63,50	79,50	3,04	73,18	67,70	84,50	3,37
AFL	25,02	22,50	27,00	1,11	24,77	19,80	28,10	1,51
ABIACRO	36,90	33,00	41,00	1,98	37,19	29,80	41,50	1,97
AELBDIA	6,07	4,60	7,10	0,51	6,14	5,20	7,20	0,41
AWRDIA	5,08	4,60	5,50	0,22	5,09	4,80	5,50	0,17
AKNEDIA	9,22	7,60	11,00	0,63	9,23	8,30	10,60	0,52
ATHOV	87,68	76,00	100,00	5,53	88,04	69,50	101,00	5,65
AUPAV-EXT	25,66	19,90	33,00	2,66	26,67	23,30	32,30	2,12
ATHV	53,95	47,00	64,00	4,11	56,80	49,00	66,00	3,96
AABV-1	72,28	60,00	89,00	7,31	72,14	63,80	88,00	6,52
ALOWLV-FLEX	35,46	30,00	44,00	2,80	36,73	31,50	41,00	2,23
AUPASF	18,45	7,80	26,00	3,99	14,60	6,80	24,40	3,97
ABACSF	13,25	6,80	34,00	5,29	11,68	6,00	23,00	3,87
AABSF-1	19,52	9,40	28,00	4,06	15,67	8,00	28,00	5,45
ATHSF	21,87	8,20	36,00	5,97	12,67	6,80	22,00	3,77
ALOWLSF	16,33	9,00	28,00	4,17	14,62	5,40	23,80	4,48
ASUPILSF	13,98	8,00	25,00	4,30	12,53	4,80	27,00	4,66
ABW	62,75	48,40	82,00	7,61	61,85	51,00	86,00	7,58

AM (arithmetic mean), minimum (lowest result), maximum (highest result), SD (standard deviation)

Table 2, Factors structure determined by Varimax rotation

Variable	Factor 1	Factor 2	Factor 3	Factor 4
AHEI	0.0787	0.2181	0.8551	0.0818
ALL	-0.0492	0.0814	0.8877	0.0553
AAL	0.1953	0.0184	0.8351	0.1399
AFL	0.1267	0.1126	0.7501	-0.2339
ABIACRO	0.4435	0.1542	0.3492	0.3418
AELBDIA	0.1700	0.4774	0.5538	0.2741
AWRIDIA	0.1519	0.3780	0.2758	0.1748
AKNEDIA	0.3700	0.7173	0.1964	-0.1264
ATHOV	0.8320	0.3487	0.1083	0.1405
AUPAV-EXT	0.7074	0.4676	-0.0187	0.2663
ATHV	0.6799	0.5793	0.1180	0.0008
AABV-1	0.8221	0.1653	0.3201	0.0610
ALOWLV-FLEX	0.4272	0.7102	0.2200	0.0728
AUPASF	0.1975	0.5501	0.1956	0.5840
ABACSF	0.7948	0.0971	-0.1375	0.4049
AABSF-1	0.3223	0.0687	-0.0205	0.8747
ATHSF	0.2687	0.7438	0.0714	0.2585
ALOWLSF	0.0883	0.8799	0.0466	0.0947
ASUPILSF	0.5984	0.2332	0.1314	0.5181
ABW	0.6541	0.4222	0.4184	0.2757
Expl.Var	4.6022	4.0607	3.7565	2.1124
Prp.Totl	0.2301	0.2030	0.1878	0.1056

Based on the GK-criteria, four main components were isolated, explaining 71% of morphological variables variance. After the Varimax rotation of the main components, a clearer structure of the isolated dimensions was achieved (table 2). The first latent dimension was under a strong influence of the volume and body height measures, and it could be defined as factor voluminosity saturated by subcutaneous fat tissue, primarily from the trunk. The second latent dimension was also influenced by voluminosity, but that of lower extremities, which was saturated by subcutaneous fat tissue (lower leg and thigh skin fold), knee diameter and somewhat lower projection of the measure of elbow diameter. The third latent dimension was influenced by measures for evaluation of longitudinal skeleton dimensionality. Leg length

most successfully determines the skeleton longitudinality, and is followed by body height and arm length. The fourth latent dimension bore least information and was highly saturated by the measures of abdominal, upper arm and back skin fold, and it could be defined as a factor of subcutaneous fat tissue of the trunk and the extremities.

Factor analysis of the morphological area of female students of Faculty of Economics (Table 2).

Factor structure of the morphological area of the female Kinesiology students (table 3).

Table 3, Factors structure determined by Varimax rotation

Variable	Factor 1	Factor 2	Factor 3	Factor 4
AHEI	0.0235	0.9033	0.1748	-0.0103
ALL	-0.3086	0.7047	0.0608	0.2672
AAL	0.1631	0.8653	0.1686	-0.1301
AFL	0.0379	0.6748	0.1378	0.3950
ABIACRO	0.1614	0.3255	0.5427	0.0624
AELBDIA	0.0068	0.0710	0.7749	0.0576
AWRIDIA	-0.0772	0.1173	0.6907	0.3235
AKNEDIA	0.5074	0.1093	0.6646	-0.1176
ATHOV	0.1777	0.2148	0.1789	0.6092
AUPAV-EXT	0.4542	0.1463	0.5907	0.4091
ATHV	0.6207	0.1482	0.3410	0.3143
AABV-1	0.2557	0.1968	0.2511	0.8176
ALOWLV-FLEX	0.5067	0.1500	0.4026	0.1014
AUPASF	0.8343	0.0822	0.1927	0.1751
ABACSF	0.5798	-0.1065	-0.0637	0.4907
AABSF-1	0.6616	-0.0597	-0.0724	0.4773
ATHSF	0.6990	0.0900	0.0209	0.1023
ALOWLSF	0.8313	-0.0777	0.1090	-0.0151
ASUPILSF	0.5493	-0.2656	0.0861	0.4493
ABW	0.4973	0.5303	0.3666	0.3700
Expl.Var	4.5572	3.1916	2.8182	2.5350
Prp.Totl	0.2279	0.1596	0.1409	0.1267

Table 4, Discriminative analysis results

Variable	AM (FA)	AM (FK)	DF	F^A	p^A
AHEI	170.15	170.11	0.002	0.001	0.973
ALL	96.55	95.36	0.092	2.545	0.113
AAL	73.30	73.18	0.011	0.039	0.843
AFL	25.02	24.77	0.058	1.020	0.315
ABIACRO	36.90	37.19	-0.045	0.601	0.440
AELBDIA	6.07	6.14	-0.051	0.784	0.378
AWRIDIA	5.08	5.09	-0.009	0.022	0.882
AKNEDIA	9.22	9.23	-0.006	0.009	0.923
ATHOV	87.68	88.04	-0.020	0.118	0.732
AUPAV-EXT	25.66	26.67	-0.128	5.007	0.027
ATHV	53.95	56.80	-0.217	14.320	0.000
AABV-1	72.28	72.14	0.006	0.012	0.912
ALOWLV-FLEX	35.46	36.73	-0.153	7.126	0.009
AUPASF	18.45	14.60	0.297	26.831	0.000
ABACSF	13.25	11.68	0.104	3.274	0.073
AABSF-1	19.52	15.67	0.248	18.644	0.000
ATHSF	21.87	12.67	0.561	95.527	0.000
ALOWLSF	16.33	14.62	0.121	4.467	0.037
ASUPILSF	13.98	12.53	0.100	3.017	0.085
ABW	62.75	61.85	0.036	0.397	0.530

AM (arithmetic mean), DF (discriminative function), F^A (F-test for ANOVA), p^A (significance for ANOVA)

Four latent dimensions were isolated as well. The first dimension was subcutaneous fat tissue, although relatively high projections showed some volume measures, especially thigh, upper arm and lower leg. The second isolated dimension was defined by longitudinality measures. The third latent dimension was mostly influenced by the following measures of transversal dimensionality: elbow diameter, wrist diameter, knee diameter, and it could be defined as a factor of transversal skeleton dimensionality. The fourth latent dimension was mostly influenced by the abdominal volume and thorax volume and it could be called voluminosity factor.

Based on the univariate analysis of the variance between the students of Faculty of Kinesiology and Economics (table 4), significant differences in the values of the subcutaneous fat tissue tests were obvious (upper arm, thigh, lower leg and abdomen), in which the students of Faculty of Economics had higher values, as well as in voluminosity measures: upper arm, thigh and lower leg volume, where students of Faculty of Economics had higher values. The discriminative analysis confirmed the differences in the morphological area between the two groups of examinees. Discriminative function was bipolar, differentiating students of Faculty of Kinesiology on one pole, with higher volume and less subcutaneous fat tissue (upper arm, abdomen, thigh and lower leg) in relation to students of Faculty of Economics, who had higher values of subcutaneous fat tissue and lower values of volume in the thigh volume and somewhat lower values of upper arm and lower leg. The Heath-Carter software was used to calculate the somatotype of the examinees for both groups. The examinees of Faculty of Kinesiology belonged to the central somatotype with values of 3.92, 3.7, 3.17, while the students of Faculty of Economics belonged to the meso-endomorph type with values of 4.56, 3.55, 2.86. The BMI value for the examinees of Faculty of Kinesiology was 20.27, while for the students of Faculty of Economics it was 21.66, what was a normal value. The % value (percentage) of fat tissue showed that the students of Economics had higher values (22%) than the students of Kinesiology, who had 16% of subcutaneous fat tissue.

Table 5, Somatotype and BMI

	ENDOMORPH	MESOMORPH	ECTOMORPH	BMI
Faculty of Economics	4,56	3,55	2,86	21,66
Faculty of Kinesiology	3,92	3,70	3,17	20,27

Discussion

In the qualitative sense of the determined morphological structures, the differences were more clearly differentiated on the dimensions of the students of Kinesiology, with emphasized mesomorph characteristics, longitudinality and transversal dimension. These characteristics were integrated into three morphological sets. On the other hand, the values of voluminosity were emphasized in students of Economics, saturated by the measures of subcutaneous fat tissue, transversality and longitudinality measures. The inactivity of the students of Economics influenced the body structure, in the sense of increased amount of subcutaneous fat tissue in the trunk, lower extremities and abdominal area. The sedentary lifestyle greatly influences the morphological characteristics of each individual. Although numerous researches prove that that kind of lifestyle was a great risk to the health, it is unfortunately becoming more common and the consequences of such lifestyle are present in younger age categories. The unhealthy lifestyle, more precisely, the increasingly present hypokinesia in very young children, reflects their morphological status as adults. The lack of movement in childhood leaves consequences in later life, primarily in the definition of morphological characteristics in the sense of increased amount of subcutaneous fat tissue. The population of female students of Faculty of Economics had normal BMI values, but the values of subcutaneous fat tissue were increased, compared to those of female students of Faculty of Kinesiology. The students of Economics have Physical Education classes once a week, for two hours, while the Kinesiology students, because of the very structure and program of the faculty, have five and more kinesiological activities a week. Mesomorph characteristics are desirable, because of the very characteristics of the kinesiological profession.

Conclusions

The overall sample of 115 female students of first and second year of Faculties of Economics and Kinesiology was divided into two subsamples, and the set of 20 morphological measures, chosen with the aim of covering the existing models of the morphological areas, was applied.

The factor analysis extracted 4 factors in each group of examinees. Variance analysis and discriminative analysis showed significant differences in the area of subcutaneous fat tissue and body volume, what coincides with the extracted factors and latent dimensions which we determined in the factor analysis. The BMI, somatotype, and subcutaneous fat percentage results also support the mentioned results that indicate the differences in the morphological structure of female students of Faculties of Kinesiology and Economics in the sense that the students of Kinesiology had lower amount of subcutaneous fat tissue and higher voluminosity. The determined differences are a new guideline for the improvement of quality of faculty classes.

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BRUCE TEST RESULTS AND BODY MASS COMPONENTS IN U20 SOCCER PLAYERS

UDC: 796.332.071:572.087.1(497.7)
(Original scientific paper)

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Abstract

The purpose of this study is to provide information about cardiovascular parameters as a response to ergometric testing by Bruce protocol and their correlation with body mass components in young adult football players in the Republic of Macedonia. A group of 204 footballers, aged 17 to 19, mean age=years was tested. Anthropometric method by Matiegka protocol was used to estimate body mass components. The Bruce ergometric test was used to estimate maximal oxygen consumption (VO2max) and general endurance. The mean values of anthropometric measures were as follows: height = 177.8 ± 6.12 cm, weight = 71.1 ± 7.69 kg; muscle mass percent (MM%)= 52.06 ± 2.51; bone mass (BM) percent 17.34 ± 1.2; body fat percent (BF%)=13.69 ±1.79. The general results of ergometric testing were as follows: heart rate at rest (HRR) was 74.45±13.42 bpm; mean exercise time (ET) =13.38 ± 2.09 minutes and VO2max = 48.4 ± 8.44 ml/kg/min. A weak positive correlation was found between MMkg (absolute muscle mass) and endurance score. A moderate positive correlation was found between heart rate in 1st minute of testing (HR1) and heart rate at the recovery period (HRR3). A moderate negative correlation was found between HR1 and exercise time (ET).

Key words: *young soccer, body components, maximal oxygen consumption, Bruce test*

Introduction

The aerobic capacity of soccer players has an important influence on their physical and technical features and their performance. It has been suggested by the American College of Sports Medicine (ACSM) that the level of fitness and the changes in fitness levels which are result of the training process, should be evaluated with sub-maximal effort cardiovascular tests (ACSM, 2000). The estimation of maximal oxygen uptake is essential for the evaluation of the aerobic capacity and the fitness level of athletes. The increment of VO2max is an overt parameter of the changes of the athletes' fitness levels (Stroyer, Hansen &Klausen, 2004; Wong, Chamari, Dellal&Wisloff, 2009; Young et al., 2005). It could be calculated from the duration of the Bruce protocol sub-maximal effort ergometric test (Bozinovska L et al., 2003).The data on pulse frequency during each minute of the protocol composes the Bruce pulse curve. These data are later used by the computer software for the calculation of general endurance, speed endurance and specific endurance.

The Bruce protocol test can be used as a screening test tool for the participation in vocational leisure and sports activities in young population. During the ergometric testing with maximal and sub-maximal effort, the cardiovascular system is being stimulated, and its physiological or non-physiological response is defined by the heart rate response, the blood pressure response and the ECG parameters (Trojacanec 1992). The maximal oxygen uptake (VO2) is the final product (parameter) of the ergometric testing, and it is of great importance for sport medicine doctors and for sport workers.

The physiological parameter VO2 max is assumed as the value of the athlete's maximum oxygen consumption during the maximum rate of work and is considered a predictor of athletic performance (Baechle& Earle, 2000; Noakes, 2001). It should be notified that the highest oxygen consumption is the result, not the cause of ultimate work rate accomplished by an athlete (Noakes, 2001). Maximal oxygen consumption is influenced by a complex interaction between the heart and skeletal muscle factors, so it is

not synonymous with athletic potential. (Noakes, 2001) Some previous studies have investigated the correlation between anthropometric status and physical performance. The body mass is a valuable predictor of success in many fitness tests in soccer, such as 20 m sprint and 30 m sprint (Wong et al, 2008; Malina et al., 2004). Body mass index (BMI) and body fat percent were in inverse relationship with results on physical and fitness tests (Nikolaidis, 2012).

The aim of the study is to determine the mean cardiovascular response of soccer players younger than twenty years (17 to 19 years) while conducting the Bruce protocol ergometric test. The second aim is to estimate the correlation of some anthropometric parameters with the cardiovascular parameters obtained from the ergometric test.

Method

To estimate the body composition of young adult soccer players, several anthropometric measurements were taken, such as height and weight, 6 skinfolds, 4 diameters and 5 circumferences. The following body components: absolute body components, expressed in their absolute values, in kilos [absolute muscular mass (MMkg); absolute bone mass (BMkg) and absolute fat mass(FMkg)] and relative body components expressed in percent (MM%; BM%; FM%) were determined with Matiegka equations.

Subjects

Two hundred and four (204) young male soccer players, average age 18.27±0.68 year, participated in regular medical check-ups, which were conducted before the start of the soccer season. These players were members of regional soccer clubs competing in I Macedonian league.

Exercise Testing

All subjects underwent standard treadmill exercise testing according to the Bruce protocol submaximal treadmill test in accordance with ACSM guidelines (Bozinovska et al., 2003. The exercise was automatically stopped when the subjects achieved the target heart rate (in beats per minute) defined as 85% of the age- and sex-predicted maximum heart rate. In our age group of 17 to 20 years, the maximum heart rate of 170 beats per minute was the targeted HR. Heart rate and blood pressure were measured at rest, during each stage of exercise, at peak exercise and during recovery. During the ergometric testing heart rates were registered at the end of each minute during the first ten minutes of exercise duration.

Statistical Analysis

The results were analyzed using SPSS software(version 17.0; SPSS, Inc., Chicago, IL, USA). A 2-way analysis of variance was used to evaluate group differences. Post hoc comparisons were determined by Bonferroni multiple comparisons. To analyze correlations between the body components and physiological parameters Pearson correlation and for Spearman test for nonparametric variables were performed. The level of statistical significance was set at $p < 0.05$. The results shown are the mean, the SD the minimal, 3rd and 97th percentile.

Results

The average values of the height, weight, lean body mass (LBM) and body mass components are shown in Table 1.

Descriptive statistics for cardio-physiological parameters obtained from Bruce protocol treadmill test are shown in Table 2. At the beginning of the test (before the treadmill started moving) the mean hart rate was 74.45 ± 13.42 beats per minute, whereas the measured individual heart rates (HR) had a wide range from 53.45 b/min to 107.7 b/min. During the first stage of the Bruce protocol, when the treadmill was moving with the speed of 2.7 km/h, without inclination, the mean heart rate significantly increased, but during this stage, the heart worked with the same average frequency. During the second stage of the protocol, while the speed of the treadmill increases to 4 km/h and the inclination increases to 12%, the heart rate increased significantly for 10 b/min. The rise of the heart rate was four (4) beats per minutes (bpm) on average. At the beginning of the third stage the heart rate increased and at the end it was 6 beats higher. At the beginning of the fourth stage the HR was 10 beats higher than the one at the end of the previous stage.

Table1: Anthropometric characteristics of young adult football players (up to 20)

	Mean	SD	3 percentile	97 percentile
Height (cm)	177.8	6.12	167.150	191.00
Weight (kg)	71.1	7.69	58.00	89.85
MMkg	37.02	4.65	29.00	47.00
MM%	52.06	2.51	47.00	57.00
BMkg	12.16	1.52	10.00	16.00
BM%	17.34	1.20	15.00	19.00
BFkg	9.78	3.14	7.00	14.00
BF%	13.69	1.76	12.00	17.00
LBMkg	60.65	6.35	50.00	76.85

MMkg-absolute muscular mass; MM%- relative muscular mass; BMkg absolute bone mass; BM% relative bone mass; FMkg absolute fat mass; FM% relative fat mass; LBM- Lean Body mass.

Table 2: Cardiovascular parameters obtained from the Bruce protocol test for young adult football players

	Mean	SD	3 percentile	97percentile
HRR * (bpm)	74.45	13.42	53.45	107.70
HR1 *	99.35	12.08	78.00	122.85
HR2	98.57	11.89	77.30	122.70
HR3	99.24	12.88	76.30	125.85
HR4	110.98	12.87	84.45	137.85
HR5	112.68	13.49	84.90	139.00
HR6	114.40	13.93	87.00	141.85
HR7	126.33	14.35	100.00	156.70
HR8	129.37	14.83	98.24	158.88
HR9	132.45	15.19	104.15	163.70
HR10	142.10	13.68	113.52	164.48
SF3	97.48	13.28	72.15	122.85
ET (minutes)	13.38	2.19	9.0	18.0
VO2max ml/kg	48.40	8.44	-	-
VO2mmkg	0.93	0.35	0.0	1.0

*HRR (Heart Rate at Rest); HR1 (Heart Rate at 1st minute…); bpm (beats per minute); ET (Exercise Time).

Table 3: Correlations (Spearman's rho) between body mass components and Brus test results

	HR1	SF3	ET	OI
MMkg	0.151	0.325	0.526	0.217*
MM%	0.023	0.086	0.324	0.261
KMkg	0.115	0.024	0.053	0.62
KM%	0.124	0.097	-0.202 **	-0.161*
FMKG	0.101	0.010	-0.142*	-0.054
FM%	0.127	0.228	-0.258	-0.325
HR1(b·min$^{-1)}$	1	0.538**	-0.578**	0.030
SF3 (b·min$^{-1)}$	0.538**	1	-0.287**	-0.017
ET (min)	-0.578**	-0.287**	1	0.130
OI	0.030	-0.017	0.130	1

*** Correlation is significant at the level 0.01 (2-tailed);* Correlation is significant at the level 0.05 (2-tailed)*

The results from the test of correlation between body components and some cardio-physiological parameters obtained from the Bruce protocol are shown on table 3. There is a weak to moderate positive correlation between absolute muscle mass (MMkg) and the HR (pulse frequency). The frequency of heart during the first minute of the test and the third minute of the recovery period was 0.538, but without statistical significance. There was a weak positive correlation between MMkg and the general endurance ($p<0.01$). The absolute fat component (FMkg) and the relative fat component (FM %) showed a weak negative correlation with the duration of the test (exercise time -ET) and the general endurance. The values of the HR at the beginning of the test showed moderate positive correlation with the HR values at the end of the recovery period, and a negative correlation with the duration of the test. HR values at the end of the recovery period also showed a weak negative (statistically significant) correlation with the duration of the test.

Discussion

The major purpose of this investigation was to determine the cardiophysiological response during Bruce ergometric test in young adult soccer players. The average heart rate at rest, during the period of two minutes before the beginning of the ergometric test was 74.45± 13..42 b/min. This value could be considered close to the upper bound of the normal HR at rest. For comparison, heart rate at rest in young Greek adults was about 70 bpm (Papathanisou et al., 2013). This result (the slightly higher HR values at rest) could be due to the presence of anxiety before the medical examination in our subjects (Ostojic, 2003), as well as due to their age - late adolescence, a period of life which is characterized by a higher level of vegetative reaction. The HR significantly increased at the beginning of the Bruce protocol which is the lowest level of effort and it remained unchanged during the first stage of the test. There was a significant increment of the HR during the periods of transition from lower to upper levels of effort (increment of the treadmill speed and inclination) within all subsequent stages of the Bruce protocol. At he end of the recovery period the heart rate decreased from the maximal value of 170bpm to the mean value of 97.48 ± 13.28 bpm, which is an indicator of excellent adaptation of the cardiovascular system of our subjects (young athletes).

The average duration of the Bruce protocol necessary for the heart rate values of our subjects to reach the submaximal heart rate of 170 bpm was 13.38 ± 2.19 minutes. There is no sufficient data on the duration of the Bruce protocol in athletes. According to Hamlin, the exercise time duration in adult athletes (mixed population, age 29.9 y) was 641.2 ± 119.8 sec (Hamlin et al., 2012).

The average values of maximal oxygen uptake (VO2) for different adult groups are age dependent and could be read from standardized tables and nomograms. The absolute value of VO2 is dependent on the body mass, which is why it is measured in milliliters oxygen per kg body mass per time unit (ml/kg/min). The average value maximal oxygen uptake (VO2 max) gradually increases during adolescence and it reaches its maximum between 15 and 30 years of age (Ostojic, 2003). The maximal aerobic capacity in athletes' population, especially in elite athletes reaches its peak between the age of 17 and 22. The average VO2max for international level male soccer players has been reported to range between 55 and 68 ml/kg/min. (Davis, Brewer &Atkin ,1992). The VO2 max average value of 63.7±8.2 ml/kg/min in elite athletes at the age of late puberty, during match was reported by Stroyer and al. (2004) (Stroyer, Hansen &Klausen, 2004).

The general opinion regarding the influence of body components on sport performance is that the active body components (muscle and bone components) are positively correlated to sport performance while the passive body component (body fat) is negatively correlated to it. (Relly et al., 2004). The results of our study showed a weak positive correlation between the body muscle component (absolute and relative) and the duration of the test, the general endurance and the pulse frequency during the recovery period. The body fat showed a weak negative correlation with the duration of the Bruce protocol and the general endurance. These results suggest that young adult soccer players with greater proportion of body muscle mass will show better results on the Bruce protocol sub maximal effort treadmill cardiovascular test, while those athletes with a greater proportion of body fat will show worse results on this test. Our results on the correlation between the HR values during the first minute of the Bruce protocol and the HR values during the recovery period suggest that the cardiovascular adaptation from the period of fatigue (effort) to the recovery period is more efficient in those athletes who show lower HR values at the beginning of the test. Young soccer players with higher values of HR in the first minute of the Bruce

protocol are less successful during this ergo metric cardiovascular test indicated by the shorter duration of the test.

Conclusion

This study presented physiologic data obtained from the Bruce protocol which could be useful indicators of the fitness status of this age population of soccer players. We conclude that anthropometric and cardiophyphysiological indicators have a meaningful role within the holistic monitoring of young adult soccer players.

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SUBJECTIVE EVALUATION OF DIFFERENT LOAD INTENSITY IN JUDO TRAINING

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(Original scientific paper)

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Abstract

The aim of this research was to ascertain the possibility of subjective evaluation of different load intensities in judo training. It was assumed that there was a strong connection between the subjective evaluation of the load intensity and the perceived heart frequency in examinees, with different training load intensities. The sample of examinees in this research consisted of 10 judokas, of average age 21±3.2 years, with training experience of 11±2.8 years. All the examinees are competitors and medal winners at the national level in the following weight classes: -73kg, -81kg, -90kg, -100kg. The sample of variables consisted of 10 measured parameters: the evaluation of subjective load intensity of an examinee (ESLI) in 5 points, and perceived heart frequency (HF) also in 5 points of measuring, or, training phases. A modified Borg RPE subjective load intensity scale CR10, ranging from 0 to 10, was used in the evaluation of subjective intensity variables. To ascertain the actual presence of several levels of load intensity, the univariate variance analysis was used for repeated measuring with Fisher LSD test in post-hoc analysis. The insight into the results showed the four levels of load intensity: low, moderate, high and maximum. The correlation analysis showed significant relationship between the ESLI and HF variables in two measuring points, at low and high intensity. The low relation between the ESLI and HF variables in other measuring points is explained by small number of examinees, relatively low variability of the RPE scale, and the application of only one parameter of objective load evaluation (HF). The research pointed out the importance of subjective evaluation of load intensity, which can be used as a good tool of training process planning and programming.

***Key Words**: judo training, intensity, subjective load, exertion*

Introduction

Judo is a combat sport and an Olympic sport that originated in Japan in 1882, and it belongs to the wrestling sports category. Judo athlete has to achieve a high level of fitness, technical, tactic and mental readiness to be able to compete or even simulate the fight during training, or else there is a high probability of injuries. Judo is an aerobic-anaerobic sport with emphasized anaerobic component. At competition, judo athletes have several fights, sometimes more than five in one day, with about 30 minutes of pause. Judo fight lasts 5 minutes, but if the contestants are equal during five minutes of active fight, the duration of the fight is prolonged (Golden score) without limits, until one of the contestants achieves certain score advantage or gets a penalty. According to this, and regarding the fact that contemporary rules of judo demand exquisite fight dynamics, we can conclude that judo athlete at a competition has to perform extremely large amount of work, that is, extreme psychophysical strain. During the year, most of the time is spent planning and programming the preparatory training units before the competition. One of the important elements of training periodization is surely the subjective evaluation of strain intensity, which is one of the best indicators of physical strain (Borg, 1982). There are many ways of determining the level of exercise intensity. Some of them are Talk Test, Target Heart Rate Range and Borg scale Rate of perceived exertion (RPE). RPE actually means our subjective feeling of our body`s hard work. Although this is a subjective evaluation of the athlete, there is a high correlation between the RPE and real heart rate (Borg, 1998). The athlete indicates a numeric value on a scale ranging from 6 to 20, which, multiplied by 10, gives the theoretic heart rate frequency. There were many researches at the field of subjective intensity evaluation, so Bonitich et al. (2005) explored the relation between RPE and heart frequency in judo fight. They obtained a statistically significant correlation of

subjective load intensity evaluation and heart frequency. They concluded that RPE, as strain indicator, can be used in planning and programming judo training. In addition, Milanez and Lima (2011) explored the relation between heart frequency, measured lactates and RPE-S in karate. RPE-S is actually the evaluation of intensity of the whole training. Chino et al. (2014) explored the difference between the objective (heart frequency) and subjective (Borg scale multiplied by 10) evaluation of load intensity in wrestlers during a wrestling fight. After each round, a significantly lower subjective load intensity evaluation was noticed, compared to the objective one, as well as significant difference of subjective evaluation of winners and losers, although a statistically significant objective load intensity evaluation was not noticed. Kuvačić et al. (2013) explored the relation between RPA and heart frequency in amateur boxing training, where they found a high, but not statistically significant correlation. Also, they concluded that the Borg scale was a valid tool for evaluation of individual intensity levels.

The aim of this research was to determine the subjective evaluation of different load intensities in judo training. It is assumed that there was a statistically significant relation between the subjective load evaluation and the observed heart rate frequency of the examinees, in different intensities of the training load.

Material & methods

The sample of examinees in this research consisted of 10 judo athletes, whose average age was 21±3.2 years, and the average training experience 11±2.8 years. All the examinees were competitors, winners of medals at the official championships of the Republic of Croatia, in the following weight categories: -66, -73, -81, -90, -100kg. The examinees participated in the measuring voluntarily, and were healthy and free of injuries prior to measuring. *The sample of variables* consisted of 10 measured parameters: the evaluation of subjective load intensity of the examinees during: *warm-up* (RPE1), *performing movement techniques* (RPE2), *performing techniques in static position– uchikomi* (RPE3), *performing throwing static techniques – uchikomi/nagekomi* (RPE4), *breathing and stretching exercises* (RPE5). The observed heart frequency during: *warm-up* (HR1), *performing movement techniques* (HR2), *performing static techniques – uchikomi* (HR3), *performing throwing static techniques – uchikomi/nagekomi* (HR4), *breathing and stretching exercises* (HR5). CR10, a modified Borg *RPE* scale for evaluation of subjective load intensity was used in evaluating *RPE* variables, with a scale ranging from 0 to 10.

The *RPE* scale overview:

0 Resting
1 Minimum intensity
2 Very low intensity
3 Little intensity
4 Sub medium intensity
5 Moderate intensity
6 Moderate intensity
7 High intensity
8 Very high intensity
9 Sub maximum intensity
10 Maximum intensity

A *Suunto Monitor System* heart frequency monitor, of Finish production, was used in evaluation of *HR* variables (heart frequency). During the measuring, the examinees wore a heart frequency belt, the *Suunto Dual Belt*. The data was read on the screen of the *Lenovo* notebook computer, by telemetric system, that is, the *Suunto Team Pod* remote data transmission technology. The instructions were given to the examinees before the measuring (training). The training consisted of five parts: warm-up, movement techniques, static techniques, throwing static techniques and stretching exercises. During each part of the training, the examiner approached the examinee and noted the value of the subjective load intensity

evaluation the examinee told him, based on the offered *RPE* scale. At the same moment of noting the *RPE*, the other examiner noted the values of heart frequency, which was unknown to the examinee. Therefore, the *RPE* and *HR* variables were collected in five points of measuring.

In concordance with the aim, the parameters of descriptive statistics were calculated: arithmetic mean (AM), standard deviation (SD), minimum (Min) and maximum (Max) result. With the purpose of testing the normality distribution, the empirical significance was calculated using the Kolmogorov-Smirnov test. In determining the statistic significant differences of heart frequency evaluation variables in five points of measuring, the ANOVA was used for the repeated measuring, with Fisher LSD test in post-hoc analysis. The Pearson correlation coefficient was calculated, with the aim of determining the connection between the subjective load intensity evaluation and the heart frequency evaluation variables

Results & discussion

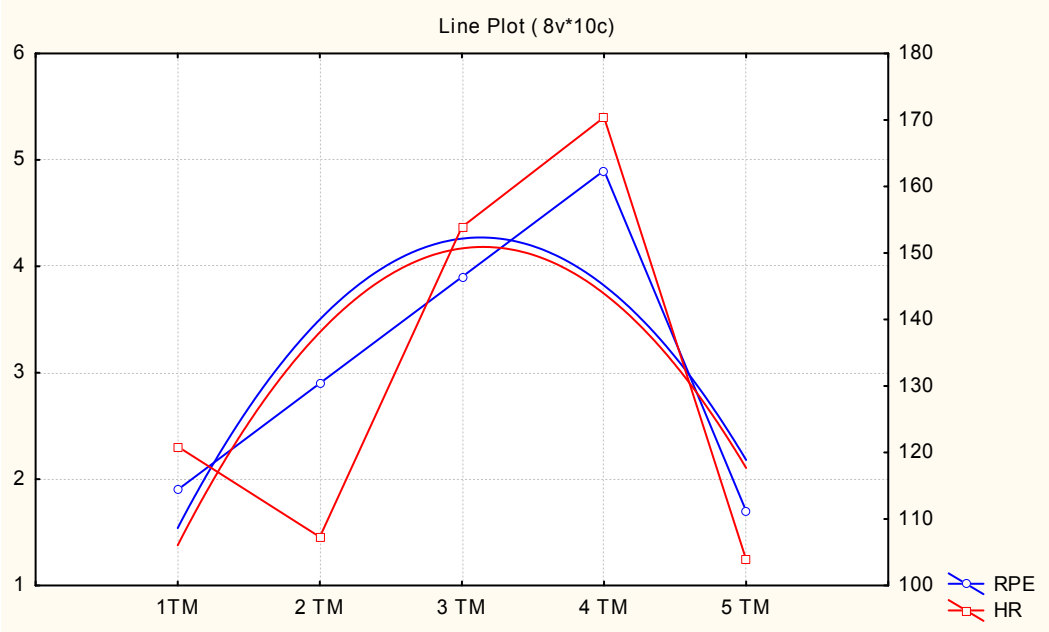
Table 1. Results of the descriptive statistic parameters: arithmetic mean (AM), minimum (Min) and maximum (Max) result, Kolmogorov-Smirnov test (K-S).

	AM	MIN	MAX	SD	K-S
RPE 1	1.9	1	3	0.74	0.25
RPE 2	2.9	2	4	0.87	0.25
RPE 3	3.9	2	7	1.45	0.23
RPE 4	4.9	4	6	0.87	0.25
RPE 5	1.7	1	3	0.67	0.27
HR 1	120.9	106	141	13.92	0.24
HR 2	107.3	97	124	9.47	0.19
HR 3	153.9	135	185	16.96	0.24
HR 4	170.4	155	190	12.22	0.14
HR 5	103.9	82	125	14.57	0.20

Boarder value of K.S test for N=10 is 0.40 p=0.05

In table 1 we can see the results of the descriptive statistic parameters: arithmetic mean (AM), standard deviation (SD), minimum (Min) and maximum (Max) result and Kolmogorov-Smirnov test (max D) of the variables used in checking the data distribution normality for the variables of the subjective load intensity evaluation, as well as the variables for heart frequency evaluation in all five points. From the K-S test results we can see that all the variables had normal distribution. Also, we can see that the average *RPE* value was lowest in the last point of the measuring (1.7), what is logical, regarding the fact that this part of training consisted of body relaxation after the hard training, with muscle stretching exercises. On the other hand, the highest middle *RPE* value was measured in the fourth point (4.9), the highest intensity part of the training in which the examinees performed two *uchi-komi* with maximum speed and explosiveness, combined with one *nage-komi*, or, three repetitions of static technique, in which after the third repetition the throwing of *uke*was performed. During the whole measuring, a minimum value of the subjective load intensity evaluation was determined, in the amount of 1, in point number one and five, while the maximum value of 7 was measured in point number three. The medium values of heart frequencies were similar to the values of subjective load intensity evaluation, so the lowest medium *HR* value was measured in the fifth point of measuring (103.9 b/min), while the highest medium *HR* value was measured in the fourth point of measuring (170.4 b/m). During the whole measuring, the minimum heart frequency was measured in the fifth point of measuring (81 b/min), and the maximum value in the fourth point of measuring (190 b/min).

Graph 1. Graphical representation of the average values of subjective load intensity evaluation and heart frequency



Graph 1 shows the average values of the subjective load intensity evaluation and heart frequency in all five points of measuring. We can see that the line of the average heart frequency value falls from the first to the second point of measuring and significantly increases in the third and the fourth point of measuring, and it suddenly falls and has the lowest value in the fifth point. The line of the subjective load intensity evaluation has a mildly different movement dynamics which linearly increases from the first to the fourth point, and, same as in heart frequency, suddenly falls in the fifth point of the measuring. To determine whether the load intensities were different in all five points of measuring, the univariate variance analysis was applied for the repeated measuring with Fisher LSD test in post-hoc analysis on the noted heart frequencies.

Table 2. ANOVA results for the repeated measurings with Fisher LSD test in post-hoc analysis

	HR 1	HR 2	HR 3	HR 4	HR 5
HR 1					
HR 2	0.00				
HR 3	0.00	0.00			
HR 4	0.00	0.00	0.00		
HR 5	0.00	0.37	0.00	0.00	

Table 2 shows ANOVA results of the repeated measuring with Fisher LSD test in post-hoc analysis. The aim of this analysis was to determine the existence of statistically significant differences in all five points of measuring for the observed heart frequencies of examinees as an objective measure of the load intensity. The results indicated that there was no statistically significant difference in load intensity between the second and the fifth point of measuring, while a statistically significant difference in load intensity was determined in all the remaining points. According to the abovementioned results, it can be concluded that, based on the observed heart frequency, there were four levels of load intensity: low, moderate, high and maximum intensity, and Kuvačić et al. (2013) obtained similar results, identifying three levels of load intensity in five points of heart frequency measuring. The low work intensity was noted in the second and the last part of the training, during the performance of movement techniques without throwing and resistance (*uke*) and during muscle stretching exercises. The moderate work intensity occurred in the first part of the training, when the examinees increased body temperature by running, stretching the joints and performing gymnastic exercises, preparing for the following part of the training. The high work intensity occurred in the third part of the training, during the *uchi-komi* technique performance, and maximum work intensity in the fourth part of the training, during the fastest and the most explosive performance of *uchi-komi,* combined with *nage-komi*.

Table 3. Correlation of the subjective load intensity evaluation variables and heart frequency evaluation variables

	HR1	HR2	HR3	HR4	HR5
RPE1	0.05				
RPE 2		-0.68			
RPE 3			0.73		
RPE 4				0.09	
RPE 5					0.19

In table 3 we can see the correlation of the subjective load intensity evaluation variables and heart frequency evaluation variables. The correlation coefficient is within the range of -0.68 for the second point of measuring and up to 0.73 for the third point of measuring. In the first point of measuring, when the examinees performed exercises with moderate load intensity (the part of training when the examinees warmed up, stretched and performed gymnastic exercises) we can notice the insignificant correlation of *RPE* and *HR* (0.05). In the second point of measuring the examinees performed exercises with low load intensity (performing the movement technique without resistance of *uke* and without throwing), the measured subjective evaluation of intensity was in a statistically significant correlation with the objective evaluation (-0.68). In the third point the correlation grew and was also statistically significant, the examinees performed *uchi-komi* with high strain intensity (0.73). In the fourth point of measuring the correlation fell (0.09), the examinees performed an exercise with maximum load intensity (the aim was the fastest and the most explosive *uchi-komi*, combined with *nage-komi*). In the last part of the training, the one with low load intensity (fifth point of measuring), the correlation between *RPE* and *HR* grew (0.19), but was still low and statistically insignificant. The obtained results indicated a statistically significant relation between the observed heart frequencies and the subjective load intensity evaluation in two points of measuring, that is, the second and the third point. Kuvačić et al. (2013) did not obtain a statistically significant relation between *RPE* and *HR* variables in boxers in all five points of measuring. It was expected that in the first point the *HR* and *RPE* results would not be significantly statistically related because of the series of physiological processes that happen during the warm-up, the preparation of the body for the intensive exercise, so the subjective evaluation is difficult. In the second point, we can see a statistically significant correlation and complete disharmony between the *RPE* and *PSI* variables, we can notice that the relation between the variables was inversely proportional; the result increase in the *RPE* variable followed the decrease of the *HR* variable result. Hadad et al. (2014) emphasize that the subjective load intensity evaluation measured by *RPE* scale was greatly influenced by physical and psychological factors. The assumption is that the examinees, by passing from the first to the second part of the training, physiologically and psychologically prepared for the increased load intensity that did not happen in the second, the so called technical part of the training, because the examinees perfected the exercise on a high level (energy loss level was brought to minimum, while the efficiency reached very high level), what was expected regarding their high average training experience value (11 years). In the third part a statistically significant relation was observed, in this case a positive correlation where the examinees successfully recognised high work intensity, and it can be explained by the period in which the measuring took place, the period of competitions when the examinees are exposed to relatively frequent discontinued and interval types of training and competitions. In the fourth point of measuring a significant relation was not determined, it is possible to assume that the examinees, in passing from the third part of the high intensity training into the fourth, got tired and were not able to objectively evaluate the load intensity in the following part of the training, which had maximum load intensity. It is interesting that in third and fourth point of measuring of high and maximum load intensity the *RPE* values were lower than the *HR* values. Furthermore, similar results were obtained by Chino et al. (2014) in the analysis of the wrestling fight. In this research, during the high intensity load, the subjective evaluation was somewhat lower than the objective one, and the researchers listed the effect of daily training as a possible cause, or the high fitness, mental, technical and tactical preparedness of the athlete. In the last point of the measuring the examinees could not successfully evaluate the load intensity, in spite of stretching, breathing and relaxing exercises whose intensity was low.

Conclusions

The aim of this research was to determine the possibility of subjective evaluation of different strain intensities in judo training. The paper indicated the importance of subjective strain intensity evaluation, which can be used as a good tool in planning and programming the training process. The analysis of the descriptive statistical measuring parameters can lead towards a conclusion that the range of heart frequency was from 82 to 190 heartbeats a minute, and that the examinees, on a subjective load intensity evaluation scale, indicated values from 1 to 7. To determine the real existence of different levels of load intensity, the univariate variance analysis was used for the repeated measuring with the Fisher LSD test in post-hoc analysis. The insight into the results determined four levels of load intensity: low, moderate, high and maximum. Low work intensity was noted in the second part of the training during the performance of the movement techniques without throwing or *uke* resistance, and at the end of the training, when the examinees stretched their muscles and relaxed. The moderate work intensity was noticed in the introductory, first part of the training, when the examinees increased their body temperature by running, stretching the joints and performing gymnastic exercises. The high load intensity was noticed in the third part of the training, during *uchi-komi* performance, and the maximum load intensity in the fourth part, when the examinees performed *uchi-komi* combined with *nage-komi*. The correlation analysis determined statistical correlation of the *RPE* and *HR* variables in the second and the third point of measuring. In the second point of measuring, the correlation of *RPE* and *HR* variables was negative (-0.68), the examinees did not successfully recognise the low load intensity; the assumption is that the examinees expected a greater load intensity, but it did not happen. Although the exercise that the examinees performed in the second part of the training demanded high quality knowing of different techniques, it still was not sensitive enough for the load intensity increase (as the examinees expected). In the third point of measuring, the correlation between the variables was significant (0.73) and the examinees recognised the high work intensity, what was explained by the development of their "sense" for the anaerobic trainings, which were relatively common for them at the time of the training. Low correlation of the remaining points of measuring can be explained by the small number of examinees, a lower sensitivity of the *RPE* scale in relation to *FS* scale, applied only in one parameter of the objective load evaluation (*HR*) and the fatigue of the examinees in the last two points of the measuring. The methods of load intensity evaluation used in this research can be useful for all the judo trainers in improving the performances of their judo athletes. In future research, it is recommended to observe other parameters of objective load intensity indicators (e.g. blood lactates).

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PETAR-SPORTS STARS-BALANCE BETWEEN PROFESSIONAL AND PERSONAL LIFE

UDC:796.071.2:929
(Review)

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Abstract

Work/life balance is at best an elusive ideal and at worst a complete myth, today's will tell you. But by making deliberate choices about which opportunities they'll pursue and which they'll decline, rather than simply reacting to emergencies, leaders can and do engage meaningfully with work, family, and community. They've discovered through hard experience that prospering is a matter of carefully combining work and home so as not to lose themselves, their loved ones, or their foothold on success. Those who do this most effectively involve their families in work decisions and activities. They also vigilantly manage their own human capital, endeavoring to give both work and home their due—over a period of years, not weeks or days.When you are leading a major project, you determine early on what a win should look like. The same principle applies to leading a deliberate life: You have to define what success means —understanding, of course, that your definition will evolve over time.Several basket players (or other sports men) who admitted to spending inadequate time with their families consider absence an acceptable price for providing their children with opportunities they themselves never had. One of these men, poor during his childhood, said that his financial success both protects his children and validates his parental struggles. Another even put a positive spin on the breakup of his family: "Looking back, I would have still made a similar decision to focus on work, as I was able to provide for my family and become a leader in my area, and these things were important to me. Now I focus on my kids' education and spend a lot more time with them over weekends."This paper addresses the relevant

***Key Words**: Sport, Work Life, Professional life, Generation, Human Resources*

Introduction

The challenges related to professional orientation has made it particularly difficult to make decisions and choices related to family and proceeding a professional career path. Sport professionals even more so have the complex path of commitment and sacrifices in order to achieve outstanding results and make them self's an household name within the sport industry. However engaging and commitment is just not enough nowadays, the fiercer the competitions is the more certain career managing is needed. Therefore we will look into the decision making process in a career crossroad of a Macedonian basketball player, taking into considerations all the aspect that would and could influence his present and future actions, and all the factors influencing his decision making related to his professional and private path. At this point it should be noted that there are many examples facing the issues, similar as those presented in this paper.

Introducing Peter who is a basketball player. He is one of the best point guards in Macedonian basketball. He belongs to the so-called Generation Y. He is born in 1985. He is married and has a little girl of 6 years. In September his daughter starts school. His wife is a graduated psychologist working in a primary school in the city center.

Peter gets an offer to continue his career by playing in one of the best and most attractive basketball clubs in the United Arab Emirates. The agreement includes playing for the club in the next four years. The amount of money he would receive is high enough to secure a comfortable and cozy living for the next 20 years if spent wisely. Further within the agreement provided is the possibility his family to join him, good accommodation for the whole family, but as a requirement rises that his wife will not work and his child would continue education at a school where the language of instruction is English and where the classmates are children of rich and famous residents in Emirates are studying as well. Furthermore, in the

terms it is specified that his private life must be subordinated to the obligations of the club, which would mean a great absence from home, which includes at least two trainings per day, one in the morning the other one in the afternoon, absence during games which taking place every three days, where also long distances must be mastered to get to the location where games takes place. Also, as a large part of his stay, he shall spend time travelling by plane and in hotel rooms in locations where the club is playing a match. So there are huge preconditions and probability for ending up with a low balance between professional and private life.

On the other hand Peter is an interesting guy. He is well aware for the following two things:

- That this kind of chance to go abroad under such conditions is once in a life opportunity.
- That he is currently in a phase of life where most of the efforts should be made stretching his strength even more (physical and mental conditions are correlated), and that although this phase lasts for almost twenty years, nevertheless it should be noted that for athletes this phase is much shorter (larger effort, possible injuries and other unforeseen events).

Furthermore, Peter, is an interesting guy due to some of its characteristics. The main feature is that he aims seeing and being present while his little daughter starts school, learns his first letters, make her first drawings.Peter has a lot of wishes. But most of all, Peter wants to strike a balance between his professional and private life.

To help Peter to make a proper and most apparent decision, in our view the primary focus should be pointed towards the characteristics of his generation (which is typical for them), and then, provide appropriate propositions what to do in order to ensure balance between professional and private life , based on the affiliation of the corresponding generation .

The Generation

In order to discover the characteristics of Peter as a member of one age group or generation, we believe it is necessary to do the following:

- *To define the concept of generation;*
- *To recognize the relevant criteria determining the appropriate generation;*
- *To determinate the appropriate generation based on the application of the relevant criteria determining the appropriate group;*
- *To determine the characteristics of the members of Generation Y (the generation to which Peter belongs);*

When discussing the notion of generation, like any other concept in the literature there can be found many different attempts. Basically, they all have one thing in common which is that under the term generation it is considered a group of people who are born, live and work in approximately the same historical time. In addition, questions are raised , to determine the criteria which define the appropriate generation. Though the following factors are determined as more significant in defining the generation (Howe, Strauss, 2002):

- Year of birth;
- A sense of belonging;
- Common beliefs and behaviors;
- Sharing a common history.

The sense of belonging means creating a perception of belonging to a generation that has its beginnings in the puberty stage and end at the stage of so called young adulthood.

In terms of *common beliefs and behaviors* concerning the attitude towards family and marriage, career , personal life , politics .

Sharing a common history involves joint participation in common and significant events that characterize the time in which they are present.

In terms of *year of birth* (which is usually considered as the fundamental criterion for determining the respective generation) different classifications could be pointed out. Belonging to an appropriate age , is characterized by specific behaviors, as well as perceptions of reality .

In this line considering one classification, the generations are divided into :

- A group of employees until 1950 ;
- Born between 1951 and 1960 ;
- Born in the period between 1961-1970 ;
- Born after 1971.

According to another classification (Martin, Tulgan, 2002) , there are the following three groups (with their " synonyms ") ;

- Baby Boom generation (born between 1946 and 1964) ;
- Generation X (born between 1965 and 1977) ;
- Generation Y (born between 1978 and 2000 - the so-called millennium generation)

Generation Y (the generation that belongs to Peter)

The first and main feature of members of this generation is that they are individuals who have never lived in a world without technology.That means that mobile phones , Internet , SMS , skype, facebook, twitter, etc., are an integral part of their lives. It is a generation that doesn't know how to calculate at heart , but does that using the help of computers and mobile phones ; generation that does not know what it means to have a film in the photographic camera; generation where the images of Fiat 750 and a blue Skoda 110 L, are interesting , but unusual (yes, they will indicate as members of this generation , that their grandfather had this type of car , somewhere in the 60s , 70s of last century), in the 80s , at a concert will during some slow songs lighter were lit and used , now in the air are risen Iphones', tablets and so on.

The organizational culture in which live, grow up and work ,the members of this generation, is characterized by high speed, uncertainty, turbulence and major changes. Reliability , inertia , slowness , low turbulence were characteristics of the generations before.(baby boom and generation X- as an example).

Generation Y consists mainly, of the children of baby boomers, but their mindset, beliefs, values and attitudes are far more different than those of their parents .

The members of the Generation Y, have the following basic features :

- Access to modern IT and other modern technology;
- Participation in decision making;
- The existence of feedback;
- Teamwork ;
- Flexible and unbalanced fees ;
- Ready for equal negotiation**.**

But also these members (Generation Y), search for a proper career, balance between work and private life and independence . Finding the perfect career is more important for them than just finding work and job satisfaction is more important than the salary provided by an organization .

So, Peter is a member of the Generation Y. One of the main features of these individuals is that they require a balance between the professional and private life. Plus, Peter is described as a person which despite everything is aiming to achieve that balance between professional and private life . Let's discuss how to help Peter to achieve that balance between professional and private life , and at the same time maximize achievements considering his career .

Establishing balance between professional life and private life

In real life , there is a high degree of duality. For that Marks made some statements (" the struggle of opposites "), and entries can be found in scenarios of old Macedonian tales. There is a number of different dimensions in which man's life is confronted the problem of duality .

This duality is especially emphasized in ensuring a balance between professional and private life. It expresses in the existence of so-called "Parallel worlds " , i.e. the division of existence into two independent parts .This approach requires , first, sorting people into categories. People who belong to our inner circle (family, friends , relatives) and people who belong to our outer circle (associates , customers , etc.) .

There can't be a happy career if there is not a happy personal life and vice versa . We choose the inner circle , but we can not choose the outer circle .An active role in ensuring the balance between professional and personal life , has the organization where the individual is employed.

In the current case, that is the Basketball club UAE . But the nature of the trainings ,matches , the very essence of the club does not allow ,a positive role of the club in terms of this issue. So here Peter must make the balance .

The first activity that needs to be done by Peter is the " management of his priorities ." Peter must be a good, effective and efficient basketball playe , but also at a same time a good parent , husband , family man. If he wants to be fully involved in the life of his little girl and the family he must give up part of his

ambitions. On the other hand, if he puts professional success first it is likely that he will have to give up some degree of involvement in the life of his little daughter and his family .

These priorities are, at the same time, the club priorities , and Peters' priorities . How to manage?

One priority for the club is achieving results. But the club also wants for Peter to be happy, if this means that the club will be getting also the most of the situation. Of course , the club does not want Peter to drag their family problems in the atmosphere of the club. Therefore, whenever discussing the balance between work and private lif , remember what are your employer considerations, and it will bring success.

The club is perfectly equipped to meet the challenges of balancing work and private life , if you deserve it with the results of their work .

For setting priorities, in practice there are several possible strategies , including:

- Finding courage to refuse demands that are beyond achieving balance between professional and private life ;
- Requesting not to quit on ourselves when planning the balance between the professional and private life;
- Self-management (recognizing the paradigm considering the "limitations of time and the inability to store and return back") ;
- Time management (determining priorities, separating the important from the not important) ;
- Stress management;
- Change management

But also the club and its management must secure:

- The support of the club and its management to ensure a balance of professional and private life;
- Determining the appropriate priorities for work ;
- Identifying the signs of exhaustion and monotony ;
- Seminars for balancing between professional and private life ;
- Encourage programs for recreation and relaxation
- Defining the occasions where the basketball players socialize with their families and with the management of the club (team-building);

The results of the misapplication of the relevant policies for the company management balancing the workplace can be:

- More frequent absences of the basketball players
- Concealing the true reasons for absence
- Reducing the morale of the basketball players
- Increased stress
- Abandoning the club

Instead of a conclusion

Stop . Enough text . We think it is not too hard to see what should Peter and his club should do.
What do you think ?

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DIFFERENCES IN BODY POSTURE AND BALANCE IN CHILDREN OF CLASSROOM TEACHING ATTENDING AND NOT ATTENDING EXTENDED STAY

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(Original scientific paper)

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Abstract

Proper postural child development depends on good structural and functional development of the body. Children have already affected their development and their posture in a negative way by reducing their movements and by increasing their weight at the same time. When observing the sagittal posture, the gravity line passes through these points: mid skull, mid shoulder, hip, knee, and slightly in front of the malleolus lateralis.The main objective of this paper is to determine the differences in indicators of posture in children attending extended and those children who do not attend an extended stay. The sample in this study included the students from 1st to 3rd grade of elementary school with a total number of 134. Subsamples of respondents are arranged within the first, second and third grade and subsamples of children attending an extended stay and those who do not attend it. Four variables were taken to determine the postural stability: anterior or posterior tilt of the body in relation to the gravity line, percentage of CG distributed anteriorly and posteriorly to the point of the projection of the center of the body on the surface of the palm of respondents and distance travelled point of the projection of the center of the body in the area of support expressed in millimeters. Measuring of the indicators of posture were exercised by one surveyor who set markers at specific points of the body in the sagittal examination, another surveyor carried out the shooting, and the third one did the analysis on the force platform recording within 3 seconds by setting a foot parallel to the platform in a calm and relaxed attitude. Based on the results the main hypothesis was confirmed: subsamples of respondents (children attending and those not attending extended stay) were significantly different in all postural parameters.

***Key Words**: foot pressure distribution, elementary school children*

Introduction

The standard posture (Latin - positura - position) is the correct relation of different parts of the body which maintains a balance between supporting structures. The spine must have a normal curvature and lower extremities must be in an ideal position to maintain balance. When observing the sagittal posture, it is clear that gravity line passes through these points: auditory opening, acromion, and hip, slightly anterior to the epicondyle knees and slightly anterior to the lateral malleolus. Derogation from any point of the correct body posture will try to compensate for posture, and eventually will become improper posture. It is important to recognize the body points that indicate postural deviations in the growth of the individual. In recent times there is increasing dispute about the problem of overweight children's schoolbags and risks to children's health, the muscle and spinal discomfort and numbness in hands and fingers, fatigue and cervical spinal musculature which is associated with improper posture. In some European countries, the law prescribes that the weight of school bags must not exceed 10 % of the body weight of the child (Fošnarić, 2007).

The younger the child, the lower acceptable load; for children who are between 6 and 7, it should not exceed 5-10 % of their body weight. If a child carries heavy burden, it will be difficult to walk faster and they will get tired easily. Conditions unwittingly exacerbate if a child carries a bag on one shoulder, in one hand or over their back all the way to their thigh. Child weakens stat - dynamics of their musculoskeletal system; there is a failure in occurrence of postural muscle which promotes the formation of inadequate posture. Hunched posture will harm the natural curvature of the spine in the long run. Postural tilt implies a movement of the head, shoulders and pelvis. The head and pelvis can tilt the

anterior or posterior to the coronal plane. The anterior tilt of the head will result in flexion of the cervical spine and posterior slope will result in the extension. The posterior pelvic tilt results in flexion of the lumbar spine and anterior pelvic tilt results in the extension of the lumbar spine. The head and pelvis can tilt laterally; from the neutral position, shoulder blade can attain anterior slope rather than posterior slope, unless the posterior slope means the blades moving back to theneutral positionof theanteriortilt. There is an increasing number of children with incorrect posture and the research has shown that in Croatian schools in children between 6-9 years, this percentage ranges from 51-62%, (Paušić, 2005) and in boys 10-13 years, from 10 to 22% (Paušić, 2007). Paušić and Kujundžić (2008) conducted a study whose objective was to determine the percentage of the weight of school bags in relation to the weight of students in some schools in Split-DalmatianCounty and therefore warn all of those concerned, that there is a problem of too heavy bags in early childhood. The weight study was carried out on a sample of 348 students attending years 1-4 and two values were established : body weight and the weight of school bags, as well as the average weight of bags in relation to body weight. The data indicated that in all years, the percentage of overweight bags in relation to students' body weight is 10% higher, reaching up to 12.5-13.8%. Paušić et al. (2009) have conducted this research on 252 students attending years 1-4. The aim of the study was to determine the percentage of overweight schoolbags in relation to body weight students and to determine whether there were differences between the students of the first, second, third and fourth years. The next objective was to answer the question of whether there is a connection established by the percentage of weight of school bags in relation to body weight and intensity of pain reported by carrying schoolbags and differences between students of different years in the variable of intensity of pain. The interview with the students was conducted immediately after the measurement of body weight and weight bags and the researcher talked with all the students involved. It was concluded that the primary factor that made the bags so heavy was carrying unnecessary didactic material; the timetable was always defined, but its implementation was not always to the plan. Ultimately, we always have to think about the future growth and development of our children. Pau et al. (2010) analyzed the foot pressure in 359 children attending primary school (6-10 years of age) in a static upright posture, in order to assess the size and features that impact stemming from the relationship between the load and the foot of the substrate. The data collected showed that the school bag had a significant increase in the total reliance on the surface (10%) and that the pressure was greater on the front of the foot (20-30%). A significant shift in the average position of the feet from the pressure centre towards the front of the foot was an indication of where the body tried to compensate for its stability at an excessive load. These results suggest that heavy burden increases the risk of foot deformities and acts as an important factor in the occurrence of changes in the structure of the foot. Kellis (2001) conducted a study where the aim was to examine the pressure distribution of the body weight on the foot in preschool boys with upright posture, during lowering and walking. Fourteen healthy boys performed five activities (standing on one leg, standing on both feet, landing in a squat on one and both legs and walking) on the platform of Musgrave system. Eight points of view were considered in analyzing the results taken: analysis of variance (ANOVA) shows that, in total, the pressure of the foot during the descent was significantly higher compared to the total pressure developed during standing on one leg or both legs and the contact during walking ($p<0.05$). Multivariate analysis of variance showed that the foot pressures were significantly greater during the descent on the other point of view and walking compared with pressures while standing on both legs ($p<0.05$). Standing and walking phases were not entirely important positions in this observation.

The aim of this study was to determine whether there were differences in body posture in children attending an extended stay (breakfast club and after school club) and those children who do not, but go to school and carry their bag every day, in order to highlight the problem and assist in their healthy growth and development .

Material & methods

The study included 134 students in years 1-3. The respondents were observed within the first, second and third year, those attending an extended stay and those who did not. The first class included 45 children, 26 of whom were attending an extended stay and 19 who did not. The second class included 42, 18 of which attended an extended stay and 24 did not. The third class included 47 children, 34 of them attended an extended stay and 13 who did not attend. Subsample of children attending an extended stay within each class were not wearing school bags and had daily physical activity within the 2 hours of afternoon rest. The students needed their parents' approval for participating in this study and signed

agreement was needed for performing further measurements as well as their approval for their children's photographs to be taken and used in this study. In order to determine the postural stability four variables had to be considered. Variable BODTIL shows the anterior or posterior tilt of the body in relation to gravity line which is estimated by taking pictures of posture and angle of inclination of the line, using computer program PostureZone Analyser Version 2.0.63 (Phillip Geary DC , MSc). The following three variables were estimated by tensiometric platform Footscan(RsScan , Inc., UK):

ANT% - the percentage of body gravity is distributed anterior to the point of projection of the body center of gravity on the surface of the support of the respondents. The value is expressed in percentages and the total percentage is 100%; it refers to the sum of the values of two variables ANT% and POS%.

POS% - the percentage of body gravity is distributed posterior to the point of projection of the body center of gravity on the surface of the support of the respondents. The value is expressed in percentages and the total percentage is 100%; it refers to the sum of values of two variables %ANT and %POS. PCTT - distance travelled point projection of the center of gravity in the area of support, expressed in millimetres (mm). Data collection was carried out within one working day and 134 school children from years 1-3 took part. Children were arranged in different subcategories according to whether they attended an extended stay in school or not. It is important to note that the measurement was performed at the end of the school year when the children were already adjusted to school regime (carrying a school bag). Measuring indicators of body posture was performed by an assessor who set markers at specific points of the body in the sagittal review, another surveyor carried out picture taking and the third performed analysis using the platform of Footscan, (RsScan , Inc., UK) recording within 3 seconds, setting foot parallel to the platform in a calm and relaxed attitude . Photography was done in the sagittal examination by placing markers in order from head to toe, to very specific areas of the body, using method of photography analysis of subjects within the computer software Posture Zone Analyser Version 2.0.63 (Phillip Geary DC, MSc), which proved to be highly reliable (Paušić, 2010). After all the children had been measured and the data stored, the processing of the obtained data started. The data processing began by analyzing photos of the children within the computer software PostureZone Analyser Version 2.0.63 (Phillip Geary DC, MSc). For each photo the assessors have set lines that match the description of the variables obtained. In this way, six reference lines were detected and for this study the line that represented the deviation of body posture towards gravity line was taken as the reference (representative) line.

The results of reference lines were entered into the matrix of data, which were subsequently processed in the statistical program Statistica 7.0 (StatSoft, Inc. 2004). Then, they analyzed the data obtained on the platform of Footscan (RsScan, Inc. UK) and for each of the children were taken three data (anterior ANT and posterior POS percentage of the body mass centre distributed from the point of projection on the surface of the respondent's palm and the distance travelled from the point of projection of the body mass line within the area of support, expressed in millimetres, PCTT). The results were analyzed by descriptive statistics and the following values were obtained: AS - mean, SD - standard deviation, min. - Minimum score, max. - the maximum score and histogram display for all reference points. The Kolmogorov - Smirnov normality test was used and it showed the following parameters: d max - p - MANOVA - a test that compares the independent categorical variables and more continuous dependent variables, most often used for comparison of several groups with respect to the more continuous variables.

Results and Discussion

Kolmogorov - Smirnov test indicated the assessment of normal distribution of all measurement tests and, except in the third variable PCTT class (the distance travelled based on body mass) which were not normally distributed variables, did not deviate significantly from the normal distribution, because the greatest discrepancies between the theoretical and the cumulative proportion (D max) were lower than limits of deviation (0.23). These results indicated the relevance of the tests. The data obtained were transformed into descriptive statistics in order to obtain the basic values of the actual situation. Within the subsample of subjects in all years, the biggest difference between the subsample of children attending an extended stay and those who did not attend, was found inside PCTT variables (the distance travelled based on body mass). The position of the projection of the body mass centre, for the children in Year 1 who did not attend an extended stay, at a standstill, was 80 mm, while the children who attended the extended stay was 39 mm. The other parameters of postural stability were not significantly different. In the subsample of children attending Year 2 and subsample of children who did not attend extended stay,

average value of the projection of the body mass centre was significantly different from the subsample of children attending an extended stay. It was 91mm for the children who did not and 32mm for the children who attended an extended stay. The other three indicators were not significantly different. In the children in Year 3, statistically significant differences were also found between the subsample of children who attended and those children who did not attend an extended stay, in PCTT variables as in previous school years. The indicator value of postural stability in the subsample who attended extended stay was 38mm while in the subsample who did not attend was 73mm. All variables between the subsample of children who attended and those who did not attend an extended stay were taken as a collective assessment of postural stability. According to multivariate analysis of variance, the two subsamples were statistically different in PCTT variable, while others contributed to it (Table 1).

Table 1. Multivariate analysis of the variables indicators in postural stability in children in Year 1, within the subsample of children who attended and those who did not attend extended stay (school hours including breakfast and after school club

	Regular stay n=19				**Extended stay n=25**					
	AS	**Min**	**Max**	**SD**	**AS**	**Min**	**Max**	**SD**	**F**	**p**
PCTT	80,61	58,00	122,00	17,26	39,29	21,00	133,00	27,18	**33,531**	**0,000**
%ANT	36,53	20,00	60,00	13,02	35,92	19,00	48,00	7,95	0,321	0,574
%POS	61,37	32,00	80,00	14,69	64,08	52,00	81,00	7,95	0,003	0,956
NAGTIJ	-1,72	-3,40	-0,60	0,93	-1,56	-2,90	-0,20	0,72	0,421	0,519

Wilks'λ = 0.493 F = 9.759 DF1 = 4 df2 = 38 p = 0.000

On the basis of Table 1, subsamples of respondents (children attending and not attending an extended stay) were significantly different in all postural indicators in Year 1.

There was also a statistically significant difference (p) variables within PCTT subsample of children in Year 2 in those who attended and the ones who did not attend extended stay, while within the variable ANT%, POS% and BODTIL, there was no statistically significant difference. Subsamples of respondents (the children attending and not attending an extended stay) were statistically, significantly different in all postural indicators in Year 2 (Table 2).

Table 2. Multivariate analysis of the variables indicate postural stability in children in Year 2, within the subsample of children who attended and those who did not attend extended stay (school hours including breakfast and after school club).

	Regular stayn=24				**Extended stay n=18**				**F**	**p**
	AS	**Min**	**Max**	**SD**	**AS**	**Min**	**Max**	**SD**		
PCTT	91,75	73,00	128,00	14,71	32,44	20,00	64,00	11,61	**199,07**	**0,000**
%ANT	36,29	19,00	60,00	11,58	39,33	11,00	55,00	11,18	0,731	0,397
%POS	63,71	40,00	81,00	11,58	60,67	45,00	89,00	11,18	0,732	0,398
NAGTIJ	-2,30	-4,90	0,90	1,32	-2,28	-7,80	-0,20	1,68	0,011	0,974

Wilks'λ=0,159 F=66,57 df1=3 df2=38 **p=0,000**

Table 3 also confirmed the same significant difference within the subsample of children in Year 3 between the children who attend and those who do not attend extended stay in PCTT variables. Subsamples of respondents (children attending and not attending an extended stay) are statistically significantly different in all postural indicators in Year 3.

Table 3. Multivariate analysis of the variables indicate postural stability in children in Year 3, within the subsample of children who attended and those who did not attend extended stay (school hours including breakfast and after school club).

	Regular stayn=13				Extended stay n=33				F	p
	AS	Min	Max	SD	AS	Min	Max	SD		
PCTT	73,58	61,00	90,00	10,07	38,28	22,00	111,00	23,65	**5,280**	**0,026**
%ANT	44,62	21,00	69,00	14,96	42,52	22,00	73,00	11,85	0,252	0,617
%POS	55,38	31,00	79,00	14,96	57,48	27,00	78,00	11,85	0,252	0,617
NAGTIJ	-2,31	-4,00	0,20	1,19	-2,54	-6,20	-0,20	1,24	0,323	0,572

Wilks'λ=0,502 F=13,2 df1=3 df2=40 **p=0,000**

Through the subsample of children who attend all the three years, the same crucial statistical indicator of postural stability (PCTT) appears. All children after Year 3, cease to be entitled to the extended stay in Croatia. The research was performed in Year 4 in the same school, but is not taken as a direct sub sample in this study. It is interesting to note that the average value of the projection center of the body mass, as a common value of the children attending and those not attending an extended stay was 79. From this, stems the conclusion that in children who have not entered the system of extended stays in school, this parameter is weaker. It should longitudinally follow and record children who start the system, in order to assess the speed of weakening their postural stability. The results of descriptive statistics showed dominantly better postural stability in a group of extended stay, because they were not subject to the additional load (carrying a school bag). Subsamples of respondents (children who attended and those who did not attend extended stay) were statistically significantly different in all postural parameters.

Conclusions

Children who were in the system of extended stay had better postural stability. School bags present quite a heavy load, in addition to carrying unnecessary didactic material, which first weakens postural stability and later on, causes bigger deformities. In Croatia, the children from the extended stay after Year 3 join the regular school system. This study showed statistically significant differences in the subsample of children who attend school, but do not attend an extended stay, in the variable projection of the center of body mass (for Year 1 and 2-100% and in Year 3-98%). The conclusion is that there is a great need for the continuation of extended stay in our system of education even after Year 3, which would lead to improving the health status and functional problems in children.

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WOMEN'S EXPERIENCES OF INFERTILITY TREATMENT REGARDING THE PRICE OF THE IVF PROCEDURE

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(Original scientific paper)

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Abstract

Monetary inquests have shown that expenditures related to IVF treatment are insignificant when compared to the net profit income coming from IVF children. For this reason, an increasing amount of importance is placed on establishing and calculating the cost (value) of the IVF procedure as a health care product, and determining its market value.The goal of this study is to define the view point/attitude of the clients/patients regarding the form of payment and their wishes in relation to the payment method of the IVF procedure (whether they want to pay independently, or a part of the cost to be covered by the Health Insurance Fund of Macedonia), as well as their opinion about the appointed price of the IVF procedure by the Health Insurance fund of Macedonia. With that in mind, in the time period from June 2009 to October 2009 - 212 anonymous surveys were assessed. The questioners were filled out by patients/couples that were appointed for an IVF procedure in the Clinical Hospital " Acibadem Sistina".Results: According to most of the patients – 58%, the Health Insurance Fund of Macedonia should cover all expenses up to 5 IVF attempts, if there is a need for that, while 28% of them thought that it is enough that the Health Insurance Fund of Macedonia covers for three IVF attempts. Majority of the surveyed clients/patients (36%) think that the price appointed by the Health Insurance Fund only partially covers the IVF expenses of the institution that carries it out. According to 22% of them, a larger sum of money should be assigned for this purpose, while 26% of them believe that the appointed price is appropriate and entirely covers the expenses of the institutions.Conclusion: In addition to the demographic benefit of boosting birthrate, the state has a lot to gain economically by treating infertility. The Governments/States should eliminate all financial and legal barriers when it comes to IVF, and with a pro-active engagement of all sorts they should support the assisted reproductive technology as a long term strategic plan that serves the interest of the state.

Key words: *Infertility, IVF expenses, IVF prices*

Introduction

Over the past few decades the birthrate in Macedonia has decreased to a great extent in relation to the increased rate of mortality. The end result is an overall low birthrate rate of the population. Above all, this translates into a decreased number of people in their reproductive age, population ageing, lack of workforce, depletion in funds, deficiency in insurance funds and the state budget, etc. The reasons for the decrease of birthrate in young adult population are: the tough financial situation, incommodious lifestyle, high rates of unemployment, and unresolved housing issues. The young adult population nowadays are less willing to get married and have children, and those that do, usually have one child. This hints a demographic crash, and calls for adequate and effective measures in preventing such a thing.

On the other hand, as a result of a degraded lifestyle and social standard, a deterioration of the health condition of the population as a whole is highly noticeable. This reflects not only on the birthrate but also on the increase of diseases that affect the reproductive system in males and females. All of this consequently leads to an increased percentage of infertility. In a case where the population is affected with a low birthrate and ageing, an organization for treatment of infertile couples is of great social interest. There are more and more couples which are offered assisted reproductive technology methods as a means of treating infertility (Malin M et al., 2001).

The assisted reproductive technologies are one of the fastest ever developed in human medicine, and they represent a sort of avanguard aspect of reproductive medicine. In a broader sense, they represent all the possible methods which can be used on the reproductive system for achieving conception and birth of an individual capable to live (Peter R. Brinsden, 1999).

The assisted reproductive methods are costly procedures. In a country like ours, with a low standard lifestyle, providing funds for these methods is not an easy task (Giwa-Osagie OF 2004). In a lot of countries, and as of lately in Macedonia too, the state aids couples by covering expenses for 3 attempts of the assisted reproduction technology or method, or through partial refunds for the received treatment. The resources invested in this by the Health Insurance Fund of Macedonia are considerably big. For this reason, establishing a quality organizational structure and a quality managerial system in the domain of assisted reproductive technology is of high state priority (Lunefeld B. Et al., 2004).

Expenses were assessed on the basis of a number of assorted medical and economical studies of cases where the government/the Health Insurance Fund wholly or partially covered the IVF procedure (Selwyn P. Oskowitz et al., 2008). Through mathematical models and complex calculations based on accounting methods developed by Kotlikoff and Sturrock, counting in the whole cost of the IVF procedure and the income benefit from IVF conceived individuals, two models were developed. The first model suggests that individuals first finish high school, then go in the direction of finishing a higher education, getting a job, and then experience problems with unemployment… The second model suggests education that spans from age 6 to age 19, and then a full time job from age 20 to age 65. These two models suggest that a successful IVF treatment results in the birth of one individual that will have an average life span of 79 years same as other average individuals which are not conceived by IVF (Mark P. Connolly et al., 2005). The final conclusion is that IVF expenses are insignificant compared to the life- long net worth income that comes from an individuals conceived by IVF (Collins J.A., 2002)

For this reason extra effort is put into calculating and determining the cost value of the IVF procedure as a health care product, and determining its market value (Granberg M. et al., 1995; Hammarberg K. Et al., 2001)

The goal of this study is to define the stance and opinion of the clients/patients regarding the form of payment for the IVF procedure (paying for it independently, or with participation from the Health Insurance Fund), as well as finding out about their opinion on the established price by the Health Insurance Fund.

Methodological Approach

At the end of the IVF procedure all of the clients/patients were asked to fill out evaluation questioners in order to find out the level of their contentment with the received treatment, their opinion on the form of payment for the IVF procedure, as well as their opinion on the established price of the procedure by the Health Insurance Fund.

In a time span from June 2009 to October 2009, 212 anonymous surveys were assessed. The surveys were filled out by patients awaiting IVF procedure in the Clinical Hospital Acibadem Sistina. The data was processed by using methods of descriptive statistics: frequency and percentages, and was put into a data base using Excel.

The means for this investigation was an evaluation questioner which was anonymously and privately filled out by clients/patients at the end of the treatment. The evaluation questioner contained 8 questions and was created to investigate whether the patients were satisfied with the way of payment for the IVF procedure. At the end all the patients/clients put the questioners in a box especially assigned for this purpose in order to insure their privacy and anonymity.

Results and discussion

According to the assessed demographic characteristics of this survey, the age classification showed that average age for women was 33.7 years old (23-43 years old), the average age for men was 37.7 years old (26-52 years old), and the infertility period was 7.6 years on average. This showed that the patients/couples were of a more advanced age. As a result of the procedure, pregnancy was confirmed in 38 % of the patients.

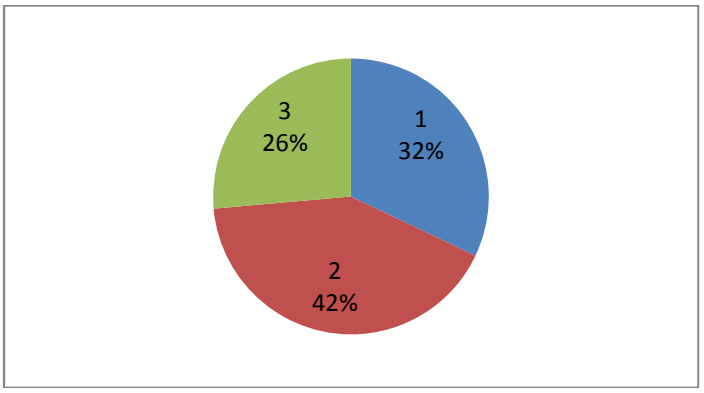
For this investigation the following questions and answers were given:

Question: If you have had several IVF procedures in the past, they were:

1. At one's own expense (68 or 32%)

2. At the expense of the Health Insurance Fund (88 or 42%)
3. At one's own expense and at the expense of the Health Insurance Fund (56 or 26%)

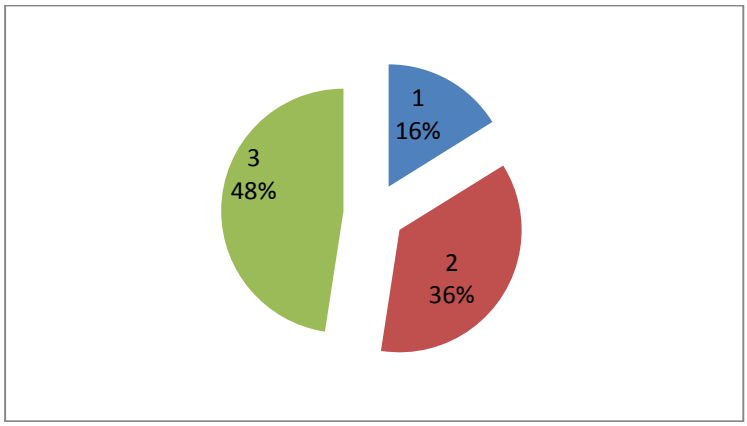
Diagram 1. Procedures for IVF and costs



Question: Do you think the IVF procedure should be:
- At the expense of the Health Insurance Fund (212 or 100%)
- At one's own expense

Question: In the case of already having experience with IVF, were you more satisfied when:
1. You had the procedure at your own expense (20 or 16%)
2. The procedure was partially paid by the Health Insurance Fund (45 or 36%)
3. You were satisfied either way (59 or 48%)

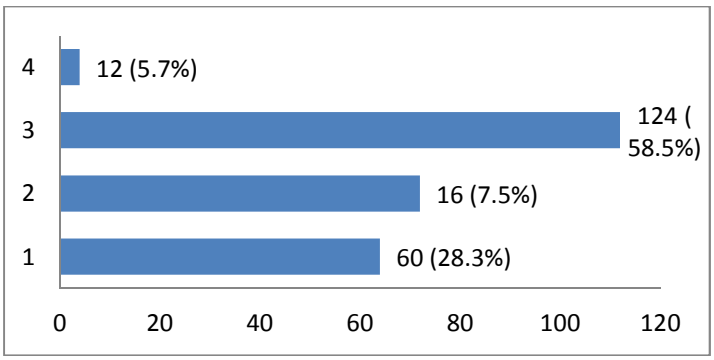
Diagram 2. Level of contentment and payment



Question: Please state the reasons for the previous answer briefly:
The most common answer as to why they preferred paying on their own was because they said it was less crowded that way.

Question: The Health Insurance Fund covers the expenses for 3 IVF attempts. Do you think that is:
1. A sufficient number of attempts (60 or 28.3%)
2. More than enough attempts (16 or 7.5 %)
3. Expenses should be covered for up to 5 attempts if there is a need for that (124 or 58.5%)
4. Expenses should be covered for more than 5 attempts (until conception) (12 or 5.7%)

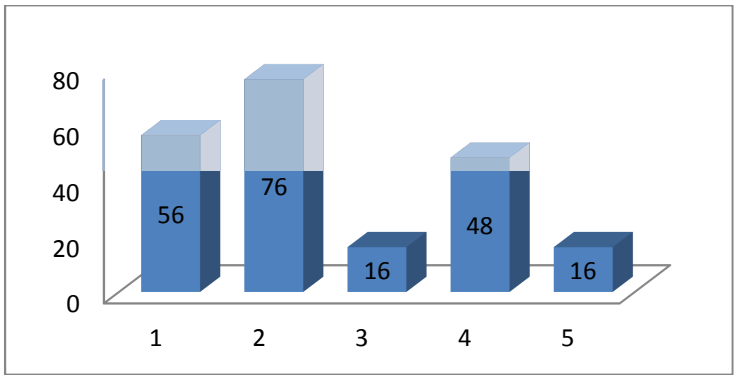
Diagram 3. IVF attempts and covering of expenses



Question: Do you think the established price of the IVF procedure by the Health Insurance Fund covers the expenses of the institutions that carry it out:

1. Yes (56 or 26%)
2. Only partially (76 or 36%)
3. No (16 or 8%)
4. It should cover more (48 or 22 %)
5. No answer (16 or 8%)

Diagram 4. The price established by the Health Insurance Fund and IVF expenses



Question: According to you what price is appropriate for the IVF procedure?
Question: Do you think that Acibadem Sistina Hospital should:

- Continue its contract with the Health Insurance Fund for an IVF procedure (210 or 99%)
- Break the contract with the Health Insurance Fund for an IVF procedure (2 or 1 %)

The diversity of the investigated clients/patients gave high credibility to the results of this investigation. Some of them paid for the IVF procedure on their own (32%), some of them were covered by the Health Insurance Fund (42%), and some of them were partially covered by the Health Insurance Fund (26%).

It is understandable that 100% of the clients/patients think the procedure should be covered by the Health Insurance Fund. About 99 % of them stated that the Department of Assisted Reproduction of Clinical Hospital "Acibadem Sistina" should continue the procedure with participation from the Health Insurance Fund. The quality of the IVF procedure was consistent whether the patients paid independently, or a part of their expenses were covered by the Health Insurance Fund. 48 % of them were either way - equally satisfied by the treatment. A smaller portion of about 36% were experiencing financial difficulties and were more satisfied when the procedure was covered by the Health Insurance Fund. It is also worth mentioning that 16 % of patients stated that they were more satisfied when they paid for the procedure themselves because doctors/staff were less busy with insurance covered patients, it was less crowded, and doctors were able to spend more time on their case.

We were interested in the opinion of the clients/patients regarding the Health Insurance Fund agreement to pay for up to 3 attempts of the IVF procedure. According to 58% of people the Health

Insurance Fund should cover up to 5 attempts if there is a need for that, while 28 % of them stated that covering for three IVF attempts is enough. A smaller number of clients/patients – about 7.5% think that covering for three attempts is more than enough, and 5.7% want all expenses covered for 5 attempts or more until conception.

Table 1. IVF price per cycle in the world

Country	Estimated cost per cycle Lowest Cost	Estimated cost per cycle Highest Cost	Data from August 2008 Lowest cost	Data from August 2008 Highest cost	Comment
Argentina			$4,160		excluding medication
Australia			$5,200	$7,000	including medication
Austria			$3,600		
Canada	$5,571	$5,766	$4,300		+2900 medication
China	$2,345	$2,428	$2,400		
Czech Republic			$2,500	$3,000	
Denmark	$4,613	$4,775	$4,000	$9,000	
Finland	$3,157	$3,267	-	-	
Greece			$4,300		excluding medication
Hong Kong	$7,819	$8,093	$10,000		including medication
Hungary			$2,200		+ $1,500 medication
Iceland	$4,856	$5,026	-	-	
India	$3,128	$3,238	$690	$1,800	
Indonesia	$4,692	$4,856	-	-	
Iran	$1,564	$1,618	$5,200		
Israel	$4,692	$4,856	-	-	
Italy	$5,318	$5,504	$3,150		
Japan	$3,910	$4,047	-	-	
Jordan	$2,345	$2,428	-	-	
Kenya			$5,000		
Korea	$1,721	$1,781	$1,600	$3,600	
Latvia			$2,500		excluding medication
Lebanon	$6,256	$6,475	-	-	
Lithuania			$3,500		
Malaysia	$7,037	$7,284	$3,400	$4,600	
Netherlands	$2,510	$2,598	-	-	Not possible privately
Norway	$4,370	$4,523	$3,200		
Portugal			$4,000		excluding medication
Qatar			$2,800		
Russia			$3,400		excluding medication
Saudi Arabia	$6,256	$6,475	-	-	
Singapore	$7,037	$7,284	$6,300	$10,000	
South Africa			$3,000		including medication
Spain			$5,600		
Sweden	$5,099	$5,277	$8,000		
Switzerland			$3,700	$4,900	excluding medication
Taiwan	$4,692	$4,856	-	-	
Thailand	$3,910	$4,047	$3,000	$5,000	
Turkey			$3,000		+$1,600 medication
UK	$3,632	$3,760	$7,500	$15,000	Range given by HFEA
Ukraine			$6,500		excluding medication
USA	$11,736	$12,146	$10,000	$15,000	including medication

The largest number of surveyed patients (36%) think that the price appointed by the Health Insurance Fund only partially covers the IVF expenses of the institution that carries it out.

Only a small number of patients (52 or 24%) think the appointed price is appropriate.

According to their opinion on the matter, the clients/patients can be divided in 3 groups:

The first and smallest group is comprised of 12 surveyed patients which share the same or similar opinion. They think that the established price by the Health Insurance Fund, and paid by the Fund to the grantor of the treatment, is realistic. According to them, the patient participation payment in the amount of 6000 denars should change and be somewhere between 15000 and 30000 denars. According to the second group of people (41 or 73%), a new price should be appointed by the Health Insurance Fund and it should be 120000 denars or up.

Table 2. IVF Price per cycle in the Balkans region

Country	IVF Cost	Medication +	Institution	Government/ Health Insurance Fund	Private
Bulgaria	1200 EUR	Medication+, + ICSI, lab+.	Dr. Sterjev		yes
Bulgaria	3000 EUR (4080 USD)	Included	Dimitrov		yes
Serbia	1950 EUR	+ medication, laboratory, biopsy...	Jevremova Papic		yes
Serbia	3500 EUR	included		up to 1x	
Croatia	1200 EUR	+ medication		yes	
Slovenia	900 EUR (1135 USD)	+ medication	Dravje	yes	
Greece	1800 EUR (2451 USD)	+medication, lab., ICSI, PGD, krio…	Chania		yes
Greece	3000 EUR (4125 USD)	+medication, lab., ICSI, PGD, krio…	Embryiogenesis IVF centre		yes
Greece	3000 EUR (4125 USD)	+medication, lab., ICSI, PGD, krio…	Serum Biomed. Institute		yes
Turkey	1800 EUR (2450 USD)	+ medication	JenePOL		yes
Turkey	2000 EUR (2805 USD)	+ medication	Gurgan Clinic		yes
Turkey	1700 EUR (2310 USD)	+ medication	Jinemad		yes
Austria	2600 EUR	+ medication, + ICSI	Kinderwunsh. Zentrum, Wien		yes
Austria	2200 EUR (2970 USD)	+ medication, + ICSI	Kinderwunsh. Institute, Wien		yes
Macedonia until 2008	1800 EUR	+ medication; + ICSI	Sistina		yes
Macedonia from 2008	1300 EUR	Included medication	Health Insurance Fund	yes (up to 3x)	

Sources: www.**ivfcost**.net/**ivf-cost**/a-**comparison**-of-the-**ivf-cost-worldwide;** www.arcfertility.com/infertility/cost of IVF.html

Unfortunately, majority of the clients/patients didn't state their opinion on this matter because they didn't feel competent enough to speak of it. But those that did state their opinion gave the Department of Assisted Reproduction in Clinical Hospital "Acibadem Sistina" an optimistic reassurance that they are largely succeeding in meeting the required criteria that one such institution should meet. These answers can also serve as guides for future activities in order to improve the quality of the treatment, to better what clients/patients like about the treatment, but also to eliminate known weaknesses of the treatment.

In 2008 the state passed a law which states that the Health Insurance Fund of Macedonia would cover 3 cycles of IVF for insured individuals. Taking into account the difficult socio-economic state of the country and the fact that a lot of people who struggle with infertility can't afford to pay independently for an IVF procedure, private medical institutions decided to make an agreement with the Health Insurance Fund of Macedonia so they can provide the IVF treatment for these people. After this, client/patient

interest peaked, the volume of work increased, but the price paid by the Health Insurance Fund to the grantor of the treatment was far lower than the realistic price calculated by independent departments for assisted reproduction. The Health Insurance Fund offered a price of 80000 denars for the whole procedure, and this price includes cost of medication for the treatment but the medication has to be provided by the independent institution that carries out the procedure. Experience and analysis have shown that the offered price is insufficient and doesn't support the efforts of the medical and non-medical staff, it doesn't take into consideration the need for improved equipment and investing in new equipment and education.

The following diagrams show actual prices of IVF/ ICSI procedures, (Table 1) the world and (Table 2) the Balkans region. These diagrams are shown in order to compare prices and determine if there is a real economic legitimacy of the price established by the Health Insurance Fund.

Analysis of prices in the world, the Balkans region, and countries with similar socio economic parameters show that at the moment the Health Insurance Fund of Macedonia has given the lowest coverage price for IVF/ICSI procedures. This goes to show that a correction of the price is necessary. The coverage price needs to increase because the current coverage price is insufficient and limits the possibilities of maintaining a high quality IVF procedure, and actively pursuing technologically advanced trends and innovations (Sabourin S., et al., 1991; Warnes G.M, 2007).

Conclusion

Staging of a quality organizational structure with a supreme management system in the assisted reproductive technology domain has become a state strategy and a priority. The final conclusion is that IVF related costs are insignificant when compared to the loss of future life- long labor income coming from IVF children as they enter the work force. In other words, treating infertility with IVF not only benefits the state by keeping the birthrate high, but it also benefits the state in terms of the economy. So, countries and their Governments should remove all financial and legislative barriers for IVF treatments, and they should support the assisted reproductive procedure financially and otherwise as a long term strategic state plan.

This will allow our IVF centers to keep the high quality and success rate of the treatments, it will allow for renewal of the medical equipment, advancement of the procedure, introduction of new therapeutic methods and a continuous quality education of the medical and non-medical staff.

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