Journal of Physical Education and Sport ® (JPES), 14(2), Art 28, pp. 178 - 185, 2014
online ISSN: 2247 - 806X; p-ISSN: 2247 – 8051; ISSN - L = 2247 - 8051 © JPES

Original Article

The relationship between overweight, obesity and physical fitness among eleven and twelve-year-old Macedonian adolescents

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Published online: June 25, 2014
(Accepted for publication May 15, 2014)

DOI:10.7752/jpes.2014.02028;

Abstract:
The aim of this research is to determine the fitness level of the Macedonian adolescents, including adolescents from both sexes with different variables of their body mass indexes (BMI). The research has been carried out on 2228 adolescents and students from 19 elementary schools throughout Central and Eastern Macedonia. The sample (average age being 14,4 ± 0,5) was split into two sub-samples in relation to their gender, 1156 being male and 1027 being female respondents. Five anthropometric measurements (IBP methodology) were used in the research, in which the body fitness was analysed using the following parameters: estimating motor skills applying seven tests of the Eurofit fitness testing battery; body composition by applying the BIA; aerobic capacity by applying a 3-minute step test. The resutls have been statistically analysed using the SPSS, v. 16.0 for Windows (variance analysis, Spearman's correlation analysis and the χ^2 test). The percentage of overweight children, classified according to the BMI (Cole et al.), is equal to 35% of the Macedonian adolescents of the same age. Both male and female respondents with a high or an increased BMI have lower muscle mass percentage and show poor test results in the evaluation of the body strength, explosive power, speed, agility and coordination, as well as a low aerobic capacity.
Key Words: Body Mass Index, Macedonian adolescents, EUROFIT, body composition, aerobic capacity

Introduction

Overweight and obestiy have called a fair amount of attention with in the last few years in various regions of Europe. Approximately 10% to 15% of the children and adolescents have an increased body fat with a chance that 20% to 25% of them will contuinue to stay in this condition when they grow up. This condition increases the risk of chronic diseases for the children who suffer it, especially when they become maturer as they grow older. As obesity and overweight have reached epidemic proportions it is justifiable to state that this condition has become one of the most important public health issues. The public health care costs for obesity and overweight can not be estimated. Although childhood obesity creates problems, such as hyperinsulinemia, risk of developing diabetis type 2, hypertension, apnoea while sleeping, asociality etc., the real health issues arrive as soon as the children grow into adults. The increased risk of any health conditions, diabetis, endocrine disorders and other diseases related to obesity and overweight appear in adulthood and their treatment can last throught the patient's lifetime. Some contributors to obesity and overweight that can not be ignored are the psychological stress and the social disfunction.

Physical fitness is known to be another important issue from a public health perspective, both in adults (Metter et al., 2002; Myers et al., 2002) and in children and adolescents (Ortega et al., 2008a, b). Studies concerning the relationship between weight status and health-related physical fitness in youth have often reported a decrease in fitness with an increasing BMI (Deforche et al., 2003; Prista et al., 2003; Graf et al., 2004; Kim et al., 2005a, b; Brunet et al., 2007; Casajus et al., 2007; Haerens et al., 2007; Huang & Malina, 2007; Fogelholm et al., 2008).

In the Republic of Macedonia there is a lack of researches, especially on a bigger group of respondents, which could give more information on the prevalence of obesity and overweight in this region, as well as its effect on the health of the children and adolescents.

In accordance with the results, as well as the fact that the period of young adolescence is related to major hormonal changes, the biggest problem in this research is the level of fitness among the Macedonian adolescents with different body weight, categorized according to the BMI. The purpose of this research is to determine the relationship between the fitness and different body weights among the Macedonian adolescents, categorized according to the BMI and the percentage of the body fat.

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Material & methods

Sample of respondents

The research was realized on a sample of 2228 adolescents of Macedonian nationality, from 19 primary schools from the central and eastern part of Macedonia, out of which 8 are located in a rural and 11 in an urban environment. The sample has been divided into two sub-samples according to gender – 1156 of the respondents are boys and 1027 respondents are girls. The average age of the respondents of both genders is 11,47 years.

The study includes students for whom their parents had previously given consent to take part in the research, who are mentally and physically healthy and who had regularly attended the classes of physical and health education. The respondents were treated in accordance with the Helsinki Declaration. Measurements were realized in March, April and May 2012, in an ordinary school environment during the regular classes of physical and health education. Experts in the fields of kinesiology and medicine, who had been previously trained to perform functional tests and to take anthropometric measures, realized the measurements.

Anthropometric measures and body composition

Measuring of the anthropometric measurements was realized at the recommendations given by IBP-International Biology Program, (Lohman et al., 1988). For estimating the morphologic characteristics the following anthropometric measures have been applied: body height in standing position (cm), body weight (kg), circumference of the upper arm and circumference of the calf (cm), as well as the body mass index (BMI).

Components of the body composition have been determined by the method of bioelectrical impedance (measuring of the electric conductivity – Bioelectrical Impedance Analysis - BIA). The measuring was realized by a Body Composition Monitor, model "OMRON - BF511", by means of which we have measured the body weight, fat percentage and muscular mass percentage. Prior to the measurement we had entered the parameters of gender, years and body height of the respondent in the Body Composition Monitor. In order to provide better precision of the results obtained from the estimation of the body composition, we ensured that the preconditions recommended by ACSM (2005) and Heyward (2006) had been fulfilled prior to each measuring.

Evaluation of Physical Fitness

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

- 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.
- Hand Grip test. With the use of a digital Takei TKK 5101 dynamometer (range, 1-100 kg), the maximum grip strength was measured for both hands.
- Standing broad jump test. The maximum horizontal distance attained, with feet together, was measured. This test evaluates lower limb explosive-strength.
- 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.
- Sit-ups 30 sec. Maximum number of sit ups achieved in 30 seconds. This test measures the endurance of the abdominal muscles
- 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.
- 3 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 children, 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.

Definition of weight status

Four weight status groups were established in this study: underweight, normal weight, overweight and obesity. The respondents were categorized according to the international genderand age-specific BMI (kg/m^2) cut-off points (Cole et al., 2000,2007). These points have been particularly established for children and adolescents aged from 2 to 18 years, separately for males and females and for 0.5 year age groups. These cut-off values are based on percentiles which change at age of 18 through BMI 18.5 kg/m^2 for underweight, 25 kg/m^2 for overweight and 30 kg/m2 for obesity (Cole et al., 2000, 2007).

Statistical analysis

The data is presented as frequencies (percentage) for categorical variables and mean (SD) for continuous variables. Gender differences in fitness and anthropometric characteristics were analyzed by one-way analysis of variance (ANOVA). Categorical data (weight status) were analyzed using the χ^2 - test. The relationships between the variables were determined by the Spearman correlation matrices. Adjustment for age was performed using analysis of covariance (ANCOVA) to examine differences in fitness level among weight status groups. Because a significant interaction was found between weight status and gender in relation to all fitness tests ($p < 0.05$), all of the analyses were performed separately for male and female respondents. Bonferroni's adjustments were used for pairwise comparisons. All the analyses were performed using the Statistical Package for Social Sciences software (SPSS, v. 17.0 for Windows; SPSS Inc., Chicago, IL, USA), and values of $p < 0.05$ were considered statistically significant.

Results

Table 1. shows the characteristics of the respondents used for this research. The results of the variance analysis (Table 1.) show that among the variables of both genders for age, arm circumference, body weight, BMI, and body fat (expressed in kg.) there are no statistically significant differences (p 0.00). Table 1. shows, as well, the prevalence of the normal, excessive body weight and obesity among the adolescents, which has been estimated based on the BMI in relation to the gender and age. The results of the $\chi 2$ ($\chi 2 = 15,253$, p 0.00) test show that there are statistically significant differences in the nourishment of the male and female respondents. The results (given in percentage) show that most of the male respondents have a high BMI (they are obese).

Table 1. Characteristics of the study sample by gender

	Total		Boys		Girls		P*
	(n=2228)		(n=1156)		(n=1027)		
Age (years)	11,47	(0,50)	11,46	(0,50)	11,48	(0,50)	ns
Arm circumference (cm)	23,15	(3,63)	23,07	(3,81)	23,24	(3,43)	ns
Thigh circumference (cm)	48,08	(6,94)	47,52	(7,19)	48,69	(6,62)	,0001
Height (cm)	152,23	(8,25)	151,72	(8,62)	152,78	(7,79)	,0024
Weight (kg)	47,58	(12,39)	47,61	(13,06)	47,55	(11,62)	ns
BMI (kg/m^2)	20,37	(4,17)	20,45	(4,25)	20,28	(4,09)	ns
Body fat (%)	22,89	(8,27)	22,18	(8,52)	23,64	(7,94)	,0000
Fat mass (kg)	11,64	(6,81)	11,34	(7,00)	11,95	(6,59)	,ns
Fat-free mass (kg)	36,01	(6,92)	36,37	(7,61)	35,62	(6,06)	,0104
Muscular mass (%)	34,19	(2,94)	35,18	(2,99)	33,13	(2,50)	,0000
Standing long jump (cm)	142,82	(25,10)	152,68	(24,66)	132,18	(20,87)	,0000
Sit-ups 30 sec. (n)	16,16	(5,04)	17,35	(5,21)	14,89	(4,51)	,0000
Bent arm hang (s)	5,94	(8,27)	8,05	(10,00)	3,67	(4,92)	,0000
Handgrip (kg)	27,21	(11,57)	29,07	(12,44)	25,20	(10,18)	,0000
Sit and reach (cm)	15,50	(6,94)	13,58	(6,43)	17,52	(6,89)	,0000
Shuttle run 4x10 (s)	13,68	(1,55)	13,21	(1,47)	14,18	(1,49)	,0000
3 minute step test (bmp)	142,48	(18,90)	134,59	(17,59)	150,89	(16,47)	,0000
Normal weight**	642	(65,11%)	312	(60,70%)	330	(69,92%)	,0000
Overweight	236	(23,94%)	128	(24,90%)	108	(22,88%)	
Obese	108	(10,95%)	74	(14,40%)	34	(7,20%)	

*P < 0.010 for difference between boys and girls (ANOVA); ns, non-significant.
**P < 0.010 for difference between boys and girls (Chi-Square Tests); ns, non-significant.

Tables 2. and 3. show the correlation coefficients between the BMI and percentage of the body fat and the anthropometric measures, and the measures for determining the body composition and the tests that measure the fitness of the respondents. Looking at the tables we can notice that all of the anthropometric measures and the measures for determining the body composition (not including the percentage of the muscular mass) show a statistically significant and positive correlation (with a .37 to .93 interval) with the BMI and the percentage of body fat for both genders.

A statistically significant negative correlation (with an interval from .-15 to .-69) has been determined between the BMI and the body fat percentage through the use of the fitness tests "Standing long jump", "Sit-ups (30 sec.)", "Shuttle run 4x10 meters", " Bent arm hang (s)", "3 minute step test (bmp)". "Handgrip", is the only test to show a positive correlation between the BMI and the percentage of the body fat, while the "Sit and reach" test shows no statistically significant results. The correlation coefficients are somewhat higher between the

percentage of body fat and the variables for determining the anthropometric measures, the body composition and the fitness tests in relation to the BMI with the same coefficients.

Tables 4 and 5. shows the average values of the parameters used for determining the anthropometric mesures, body composition and the tests for determining the fitness among the different groups of respondents, formed based on the BMI.

The values of the arithmetic means and the amount of the statistical significance in Tables 3 and 4 show that both male and female adolescents who are mildly overweight and overweight achieve better results in the "Handgrip (kg) " test in comparison to the respondents with a normal body weight (p 0.00), however, worse results in all of the other fitness tests. The test "Sit and reach" shows no statistically significant differences among the adolescents with a normal, increased and a high BMI.

Table 2. Correlation quotients of BMI and body fat percentage with anthropometrical and physical parameters (boys)

	BMI				Body fat percentage			
	T	N	O	OB	T	N	O	OB
Anthropometrical parameters								
Arm circumference (cm)	*,93	*,92	*,94	*,94	*,82	*,81	*,85	*,87
Thigh circumference (cm)	*,89	*,87	*,90	*,92	*,79	*,76	*,82	*,84
Height (cm)	*,37	*,31	*,47	*,49	*,16	*,11	*,23	*,30
Weight (kg)	*,91	*,89	*,93	*,94	*,74	*,71	*,80	*,82
Muscular mass (%)	*-,55	*-,44	*-,52	*-,53	*-,79	*-,72	*-,72	*-,74
Fat mass (kg)	*,95	*,94	*,97	*,97	*,96	*,96	*,97	*,97
Fat-free mass (kg)	*,70	*,65	*,76	*,78	*,43	*,39	*,53	*,57
Physical parameters								
Standing long jump (cm)	*-,38	*-,38	*-,46	*-,46	*-,52	*-,53	*-,55	*-,57
Sit-ups 30 sec. (n)	*-,25	*-,24	*-,32	*-,33	*-,32	*-,31	*-,33	*-,39
Bent arm hang (s)	*-,65	*-,58	*-,67	*-,67	*-,69	*-,64	*-,69	*-,71
Handgrip (kg)	*,24	*,27	*,19	*,22	*,08	*,10	,07	,07
Sit and reach (cm)	-,04	*-,10	*-,13	*-,12	-,04	*-,09	*-,13	*-,16
Shuttle run 4x10 m	*,26	*,20	*,39	*,38	*,35	*,31	*,41	*,45
3 minute step test (bmp)	*,39	*,36	*,45	*,47	*,45	*,44	*,49	*,51

T = Total; N = Normal weight; O = Overweight; OB = Obese; * = p < 0.05;

Table 3. Correlation quotients of BMI and body fat percentage with anthropometrical and physical parameters (girls)

	BMI				Body fat percentage			
	T	N	O	OB	T	N	O	OB
Anthropometrical parameters								
Arm circumference (cm)	*,91	*,88	*,90	*,91	*,81	*,79	*,85	*,87
Thigh circumference (cm)	*,88	*,85	*,88	*,88	*,79	*,75	*,82	*,84
Height (cm)	*,35	*,28	*,40	*,42	*,17	*,12	*,24	*,30
Weight (kg)	*,89	*,84	*,89	*,89	*,73	*,68	*,79	*,82
Muscular mass (%)	*-,56	*-,54	*-,57	*-,63	*-,79	*-,76	*-,76	*-,78
Fat mass (kg)	*,91	*,88	*,90	*,91	*,81	*,79	*,85	*,87
Fat-free mass (kg)	*,88	*,85	,88	*,88	*,79	*,75	*,82	*,84
Physical parameters								
Standing long jump (cm)	*-,25	*-,25	*-,13	*-,17	*-,40	*-,38	*-,25	*-,26
Sit-ups 30 sec. (n)	*-,15	*-,15	-,07	*-,11	*-,26	*-,25	*-,14	*-,21
Bent arm hang (s)	*-,60	*-,52	*-,59	*-,61	*-,67	*-,61	*-,66	*-,68
Handgrip (kg)	*,29	*,33	*,33	*,35	*,11	*,14	*,19	*,22
Sit and reach (cm)	,04	*,11	-,01	,05	,03	,09	,03	-,03
Shuttle run 4x10 m	*,15	*,11	*,14	*,14	*,28	*,25	*,21	*,26
3 minute step test (bmp)	*,32	*,33	*,24	*,29	*,43	*,43	*,38	*,36

T = Total; N = Normal weight; O = Overweight; OB = Obese; * = p < 0.05;

Table 4. Significance of differences in physical fitness components in the various BMI categories in the boys

	Normal weight		Overweight		Obese		F	Sig.	Post hoc pairwaise comparisons
	M	SD	M	SD	M	SD			
Arm circumference (cm)	20,98	2,08	25,30	1,80	29,05	1,86	793,60	,000	1 & 2; 1 & 3; 2 & 3
Thigh circumference (cm)	45,53	4,31	54,73	3,69	61,10	4,44	686,30	,000	1 & 2; 1 & 3; 2 & 3
Height (cm)	149,43	7,95	153,64	8,08	156,64	6,76	43,31	,000	1 & 2; 1 & 3; 2 & 3
Weight (kg)	40,34	6,81	54,95	8,15	69,56	8,92	717,61	,000	1 & 2; 1 & 3; 2 & 3
Muscular mass (%)	35,35	2,79	33,41	2,39	31,69	2,36	91,92	,000	1 & 2; 1 & 3; 2 & 3
Standing long jump (cm)	151,81	25,30	136,29	23,01	128,19	19,60	53,26	,000	1 & 2; 1 & 3; 2 & 3
Sit-ups 30 sec. (n)	16,63	5,12	14,29	5,81	10,64	6,37	51,10	,000	1 & 2; 1 & 3; 2 & 3
Bent arm hang (s)	8,67	9,62	1,51	3,25	0,36	1,43	82,03	,000	1 & 2; 1 & 3
Handgrip (kg)	19,57	4,52	22,00	5,44	24,07	4,70	42,58	,000	1 & 2; 1 & 3; 2 & 3
Sit and reach (cm)	13,24	6,26	13,38	7,25	12,56	7,30	0,46	ns	
Shuttle run 4x10 m	14,33	1,36	14,81	1,35	15,38	1,40	26,25	,000	1 & 2; 1 & 3; 2 & 3
3 minute step test (bmp)	133,67	17,72	142,01	17,44	150,13	15,74	39,13	,000	1 & 2; 1 & 3; 2 & 3

1 = Normal weight; 2 = Overweight; 3 = Obese

Table 5. Significance of differences in physical fitness components in the various BMI categories in the girls

	Normal weight		Overweight		Obese		F	Sig.	Post hoc pairwaise comparisons
	M	SD	M	SD	M	SD			
Arm circumference (cm)	21,23	2,14	25,28	1,91	28,94	1,76	612,45	,000	1 & 2; 1 & 3; 2 & 3
Thigh circumference (cm)	46,17	4,54	54,82	4,00	60,80	4,77	499,38	,000	1 & 2; 1 & 3; 2 & 3
Height (cm)	149,94	7,82	152,51	7,53	156,49	6,89	27,82	,000	1 & 2; 1 & 3; 2 & 3
Weight (kg)	40,99	7,11	54,04	7,34	68,61	8,41	584,98	,000	1 & 2; 1 & 3; 2 & 3
Muscular mass (%)	34,54	2,22	32,39	2,22	31,02	1,96	125,26	,000	1 & 2; 1 & 3; 2 & 3
Standing long jump (cm)	145,07	21,78	131,67	21,97	125,38	18,84	44,50	,000	1 & 2; 1 & 3
Sit-ups 30 sec. (n)	16,05	4,82	13,78	5,52	10,88	6,02	40,42	,000	1 & 2; 1 & 3; 2 & 3
Bent arm hang (s)	6,61	7,47	1,25	2,88	0,39	1,45	67,61	,000	1 & 2; 1 & 3; 2 & 3
Handgrip (kg)	19,17	3,93	21,20	4,96	23,41	4,76	40,44	,000	1 & 2; 1 & 3; 2 & 3
Sit and reach (cm)	14,13	6,46	14,76	7,58	13,90	8,65	0,60	ns	
Shuttle run 4x10 m	14,65	1,31	15,10	1,30	15,59	1,32	21,14	,000	1 & 2; 1 & 3; 2 & 3
3 minute step test (bmp)	140,48	18,06	147,12	17,74	155,28	15,32	26,05	,000	1 & 2; 1 & 3; 2 & 3

1 = Normal weight; 2 = Overweight; 3 = Obese

Dicussion

Overweight and obesity in children and adolescents becomes a global epidemic and threatens its spread in Macedonia. 35% of the 11 and 12-year-old respondents, who were classified according to the BMI criterion, are overeating and obese. Various international studies have also shown similar results. About 33% of the school students in Baltimore, classified according to the age-specific reference values of the BMI, are obese and tend to overeat (Jehn et. al., 2006). Ortega and his associates had carried out a research involving Spanish adolescents as subjects (n=2.859) and confirmed a prevalence of overweight including obesity with 25.7% among the male subjects and 19.1% among the female respondents. (Ortega, 2007). Al-Nakeeb and his associates' research results in over 37% of obesity and overeating among the Birmingham adolescents. The research has also shown that every fifth child's body composition contains more than 30% body fat (Al-Nakeeb et. al., 2007). Ostojić and his associates realized a research on 6-14-year-old Serbian children which resulted in obesity and overweight prevalence rate of 38.3% among the boys and 40.4% among the girls. Overweight and obesity among adolescents is mostly prevalent in Southern European countries (Malta, Greece, Italy, Portugal), including Macedonia, as well. Obesity prevalence is not as high in the developed Western European countries, excluding the Great Britain. The Scandinavian and Central European countries have low obesity rates. Eastern European countries have the lowest obesity prevalence in the EU (Currie et al., 2004).

Our study results, also, suggest that the male respondents have the tendency to have higher obesity prevalence in comparison to girls (14.40% among the males to 7.20% among the girls). These results are most probably they way they are due to the fact that girls usually take more care of their looks and eating habits. Furthermore, boys spend less time engaging themselves in spontaneous physical activities and more time on

sedentary activities (working on the computer, watching television, etc.). However, this has to be verified with further researching.

Over 26% of the respondents have a body composition that consists of 30% body fat. The high rate of body fat is related to an increased risk of acute and chonic conditions, especially osteorathritis, higher blood pressure, diabetis melitus and cardiovascular diseases. Incresed body fat can, also, result in low quality lifestyle, personal and financial hardships for the person having it, his/her family and the society, as well as it can reduce his/her longevity(Williams et al., 1992; Aristimino et al., 1984; Berenson et al., 1980; 1982; Dugan, 2008).

The results of this study clearly show that the extra kilograms and obesity have an influence on the health related fitness among 5th and 6th grade students, at an age of 11 to 12-years. The negative influence has its highest effect during the cardiorespiratory endurance, body strength, explosive strength, speed, agility and coordination measurement tests. The successful results of most of these tests, in which the fat mass stands in for ballast weight, depend on how the body, itself, moves or on overcoming the body resistance or some parts of the body's resistance. These are motor manifestations which are influenced by the regulation mechanisms of the excitation's intensity and duration (Kurelić et al., 1975). These mechanisms are obviously more efficient among the youth with blanced weight and height, i.e. lower BMI and body fat values. This concurs with other international researches with a target audience of children aged 5 to 17 years (Baine et al., 2009; Malina et al., 1995; Minck et al., 2000; Deforche et al., 2003; Prista et al., 2003; Graf et al., 2004; Kim et al., 2005a, b; Brunet et al., 2007; Casajus et al., 2007; Haerens et al., 2007; Huang and Malina, 2007; Fogelholm et al., 2008).

The correlation coefficients between the BMI and the body fat percentage and the anthropometric measurements, body composition measurements and physical fitness abilities indicate that the male respondents achieved better test results in comparison to the female respondents.

Macedonian adolescents who are mildly overweight or overweight achieve poorer results in the following tests: tests "Standing long jump", "Sit-ups (30 sec.)", "Shuttle run 4x10 meters", " Bent arm hang (s)", "3 minute step test (bmp)" ($p < 0.001$). Other researches with similar results support the results evaluated in this research (Deforche et al., 2003; Kim et al., 2005; Graf et al., 2004). Regarding flexibility, this research has shown that the respondents who are mildy overweight or overweight achieve similar results as the respondents who have a normal weight do. Two Taiwanese researches can also verify this statement. However, the results of some researches carried out in the Western countries indicate that overweight girls had achieved better results when it comes to flexibilty than normally weighing girls, whereas the same can not confirmed for the results of the male respondents. (Prista et al., 2003).

The acquired data from this research is also used in scientific planning and in developing physical education curriculums in order to achieve optimization of the relationship between the quantity of the subcutaneous fat and the muscle mass so that an opportunity to maximize the motor skill functioning with a wide spectrum of abilities, especially when it comes to strength and endurance (Katić, 2003). The objective of the physical education classes at this age should be focused, among other things, on reducing the body fat and gain more muscle mass.

The curriculum should be designed in order to match these aims, such as optimization of the somatotype's phylogenesis, manage a proper motor development and the most important – having a positive influence on the health status of the students.

Conclusions

The percentage of the overweight and obese children, classified according to the BMI of Macedonian adolescents at the age between 11 and 12-years, reaches up to 35%. Regarding the gender, a higher percentage of the overweight and obese children are male, whereas a bigger percentage of the undernourished ones are female.

Macedonian adolescents with a mildly high or a high BMI have: reduced aerobic capacity, decreased muscle mass percentage, higher percentage of body fat and receive poor results on the tests which determine their physical fitness. The adolescents who are mildly overweight or overweight achieve poorer results in the "Standing long jump", "Sit-ups (30 sec.)", "Shuttle run 4x10 meters", " Bent arm hang (s)" tests, however, they achieve similar results regarding their flexibility. "Handgrip (kg)" is the only test with positive results.

The correlation coefficients between the BMI and the body fat percentage and the anthropometric measurements, body composition measurements and physical fitness abilities indicate that the male respondents achieved better test results in comparison to the female respondents.

Acknowledgements

We hereby express out great gratitude to the adolescents who took part in this study, as well as to their parents and teachers for their cooperation. Special gratitude to the councils of the municipality of Strumica, Kisela Voda and to the Faculty of Physical Education in Skopje which provided funds for realization of this study.

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