



Differences in Anthropometric Traits and Trend of Changes in High School Students

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Abstract

Objectives: Anthropometric traits are closely related to health improvement as well as motor skills, psychological and sociological development. Therefore, the aim of this study was to investigate the differences in anthropometric traits of high school students and trend of changes among them.

Methods: The anthropometric parameters including weight, height and body mass index (BMI) were measured in 60 male and female students, aged 17 ± 0.5 years. Descriptive statistics and t-independent test was used to analyze the data.

Results: The results suggested that there were statistically significant differences in the height ($t = 7.40$; $P < 0.000$) and body weight ($t = 3.62$; $P < 0.001$) of male and female students, while no significant difference was found in BMI values in the two groups ($t = -0.33$, $P > 0.001$). In addition, it was suggested that 68% of male and female high school with mean BMI of 25 and 13 respectively, had normal nutrition status. 14.6% of male and 10.5% of female students had malnutrition. 21% of female students and 17% of male students had an excessive malnutrition.

Conclusions: Although, today's development is moving towards the advancement of technology, the life style especially nutrition status and physical activity needs to be seriously considered. However, much research is needed to understand the effective factors on life style of different age groups especially students who are so involved in threaten of hypokinesian lifestyle.

Keywords: Body Mass Index, Obesity, Anthropometry

1. Background

A large number of research in health sciences as well as its subdisciplines such as physical education and sport sciences are related to the study of certain segments of the psychosomatic status of a person. The primary basis of psychosomatic status is the growth and development of the human organism that defines quantitative and qualitative anatomical, physiological and psychological changes, and the development of sensory and motor skills. when considering the effects of phylogenies and ontogenesis on the developmental trend of human, a number of complex endogenous (heredity, race, hormonal status, sex) and exogenous factors (nutrition, socioeconomic condition, geographically-climatic, birth weight, chronic diseases, seasonal differences, secular increase, physical activity) must be noticed (1). The prevalence of obesity in children has been on the rise globally and currently con-

stitutes a public health problem (2) due to the accelerated rate of unhealthy diet, reduced or lack of enough movement (i.e., hyperkinesia lifestyle) (3). Hypokinesia consequences are mostly related to the common chronic and metabolic syndrome disease and it is often more occurred in older than in younger school ages. Since, younger children neutralize the problem unconsciously through the game, while this problem increases with age (4). Diagnosis of overweight and obesity status in younger ages has been of interest among researchers in order to gain an insight into the current status of growth and development potentials in any community (5, 6). Extra body weight during childhood and adolescence is associated with adverse health consequences throughout the life span. In young children, physical activity, even without reducing calorie intake is a very effective method for reducing the risk of chronic illnesses, regardless of the degree of obesity (7). There are some studies reporting that the health re-

lated risk factors of obese persons who regularly engaged in physical activity is no greater than the sedentary people with ideal body mass. Having considered 141 articles in PubMed, It was suggested in a review study that grades 2 and 3 obesity were significantly with higher all-cause mortality compared to grade 1 and overweight (8).

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 (9). The results suggested that the prevalence of overweight and obesity were significantly increased by 60% - 70% between 1985 and 1997 in both males and females. From 1969 to 1985, there were no changes in the prevalence of overweight and obesity in girls, hile it was increased by 35% among boys. The results of the six-year follow-up of 296 patients (aged 10 to 16 years in 2001 and 2007) showed that there was no difference in BMI in the sixteen year olds. It was also shown that low values of aerobic capacity with high BMI at age of 10 years predicts obesity at the age of 16. As a result, it was stated that normal weight and good aerobic fitness at the age of 10 would result in lowering the BMI in the 16th year. Perception of body weight is a strong determinant of nutrition habit and weight management in adolescents. Adolescents who have normal weight, but think of themselves to be overweight, have a higher risk of eating disorders such as anorexia nervosa (10). On the other hand, adolescents who are overweight but do not see themselves as such, will probably not participate in weight control such as diet and exercise (10).

It is estimated that 15 to 20% of American children aged 6 to 17 years of age have an excessive body mass, which is an alarming result (11). The concerning problem of obesity determined the European Union to consider the day of May 22, 2010 as the first European obesity day (EOD). EOD is a pan European independent initiative that unites all the responsible factors for making the public aware regarding the weight excess problems, and recognizing obesity as a chronic illness.

Measurement of the morphological characteristics of the human body is an integral part of a some applied research, primarily in the field of sports medicine, as well as in the field of physical education and sport sciences (12). One-time anthropometric measurement, not only provides an insight into the average state of physical development, but also extends to helping the Health authorities and policy makers for practical purposes. Furthermore, the anthropometric measurements enable the setting of norms. The evaluation of the morphological characteristics through the standard index gives the examiners specific guidelines (6). BMI is used to define the medical standard of obesity in many countries since the mid-1980s, and this method of assessment is also used in statis-

tics of the world health organization (13). Based on the evidences, increased BMI values increase the risk of cardiovascular diseases (hypertension, myocardial infarction, and pulmonary diseases, sleep apnea syndrome) (14-16). However, the basic critique of BMI as an indicator of child nutrition is that it does not directly measure the amount of fatty tissue. In teenagers with well-developed muscles, it can be interpreted as an overweight person, while a child with normal BMI could have extra fat mass in some sites of body. On the other hand, BMI does not capture information on the mass of fat in different body sites during the growth and development processes. It must be noted that the degree of development also differs among different ages, gender and ethnic groups. Therefore, the determination of obesity in children is done using special curves of the so-called, BMI percentiles that are adapted to the age and gender of the child. Although, a large number of children with high BMI are indeed obese, other parameters such as waist/hip ratio (WHR), waist/stature ratio (WSR) should be used to diagnose obesity. BMI percentiles are a clinical indicator used to compare children of the same age. In connection with the above mentioned, this research was carried out with the aim of the diagnosing somatic status of pupils of older school age and possible differences in quantitative indicators of somatic status, depending on sex using BMI and its percentile.

2. Methods

The research covered the population of elderly school children from Bijelo Polje (Montenegro). The sample consisted of a total of 60 respondents with mean age of 17 ± 0.5 years, divided into two sub-classes: 41 male students (average height, 178.07 ± 7.52 cm; body weight, 68.29 ± 10.91 kg; BMI, 21.52 ± 3.06 kg/m²) and 19 female students (average height, 163 ± 7.14 cm; body weight, 57.89 ± 9.75 kg; BMI, 21.82 ± 3.49 kg/m²) who regularly attended physical education in secondary vocational school. The measurements were done in the physical education room of the secondary vocational school in Bijelo Polje, according to the IBP protocol. All students participated in measurement voluntarily. Variables taken for the analysis of somatic status included:

- 1- Body height (AVIS-cm),
- 2- Body weight (AMAS-kg),
- 3- Body mass index (BMI-kg/m²).

The body height was measured by an Anthropometer, while the body weight was measured by a digital scale. The data obtained in the research were processed in the statistical package SPSS Statistic 20.0. The results were obtained by descriptive statistics and the T-test for independent samples. For the assessment of student's nutritional

status, the BMI (kg/m^2) and percentile range standard were applied.

Table 1. Values of the BMI and Percentiles Relative to Nutrition Status

Status	Percentile Range	BMI, kg/m^2
Malnutrition	< 5th	< 18.5
Normal nutrition	5th to 85th	18.6 - 24.9
Excessive nutrition	85 to < 95th	25 - 29.9
Obesity I degree	> 95th	30 - 34.9

3. Results

The physical characteristics of subjects can be seen in [Table 2](#). The average body height of the male students (178 cm) is considerably more than the female students (163 cm). It is evident that the values of CV% show a lower homogeneity of body height in female (4.38%) compared to male students (4.22%). The same results for the values of the body weight was found (68.29 versus 57.89 for males and females, respectively). It is also evident that the minimum body weight of both sexes is almost equal (about 1 kg different), as opposed to the maximum weight, where the difference is 20 kg. Female students also showed less homogeneity of results (CV% 16.84) than male students (CV% 15.97). Generally, in this variable, both sub-samples are defined with a significant low homogeneity, which is confirmed by the values of the range of results (Rank). Body mass index (BMI) as an indicator of the physical status of both sub-samples showed quantitatively quiet equal values (BMI of male students equals to $21.52 \text{ kg}/\text{m}^2$ or 54th percentile and BMI of female students is $21.82 \text{ kg}/\text{m}^2$ or 62th percentile), which is a significant homogeneity in relation to the average values of body height and body weight.

To determine the statistically significant differences between sexes, the T-test for the significance level at $P < 0.01$ was applied ([Table 3](#)). By inspecting the Table, it is evident that there were significant differences in anthropometric measurements of body height ($t = 7.40$; $P < 0.01$) and body mass ($t = 3.62$; $P < 0.01$), unlike BMI weren't significantly different between males and females.

Trend of BMI changes in relation to nutrition status is seen in [Figure 2](#). of male and female students had normal nutrition and 14.6% of male students and 10.5% of female students had malnutrition. 21% of female students and 17% of male students had an excessive malnutrition.

4. Discussion

Obesity poses one of the most serious health concerns in Europe. In order to have a real chance to fight this phenomenon and keep it under control, all factors involved must be taken into account (17). The research was carried out with the aim of diagnosing the somatic status of adolescent students and the difference in quantitative indicators of somatic status depending on the gender. Although the number of the students was 60, the results well determined the trend of changes in the psychosomatic status of the body with the emphasis on changes in physical status. It is known that over-nutrition in children and adolescents is a complex disorder whose incidence has been increased significantly in recent years, which is a major health problem in the developed world (18). Obesity mostly occurs as a result of insufficient physical activity and sedentary lifestyle from the earliest age. Previous studies have suggested that regular physical activity is associated with health other than any genetic factor (3, 19). The assumption is that low physical activity has a major negative impact on the psychomotor and psychosomatic traits of students. Studies have shown that the incidence of obesity is increasing in all age groups in both sexes. The more the index exceeds the scope of normal value, the greater the risk of the development of various diseases of the heart, diabetes and high blood pressure.

By considering the trend of physical changes in male and female students, we would come to the conclusion that most of the subjects had normal nutrition, while a few of the male and of female students had malnutrition status. The result is supported by a six-year follow-up study in 300 subjects aged 10 - 16 years (20). It was suggested that high BMI at age 10 predicts obesity at the age of 16.

The results of our research are in accordance with a study that showed significant differences in terms of body height and body mass between male and female students (21). Another indicator which was not taken into account in the study is waist circumference which can be a useful indicator of nutritional status in children and in adults (22), so studying WHR in future studies is highly recommended. Based on a study, people with the highest waist circumference had the greatest tendency for hypertension, diabetes, increased blood fat and metabolic syndrome, compared to those with a normal waist circumference (22)). It is known that heredity plays an important and key role in the growth and development in humans. In research on the effect of heredity on BMI, It was found that hereditary had a major influence on body weight and BMI (23). They concluded that body weight and obesity were under strong genetic control, and that the environment in which a person grows, has relatively little influence. Hence, the impor-

Table 2. Descriptive Statistics of Students^a

Variables	Mean	Min.	Max.	Rang	SD	CV%
Height, cm						
Male	178.00	163.00	203.00	40	7.52	4.22
Female	163.00	148.00	172.00	24	7.14	4.38
Weight, kg						
Male	68.29	49	102	53	10.91	15.97
Female	57.89	48	82	34	9.75	16.84
BMI, kg/m²						
Male	21.52, 54 ^a	16.96, 11 ^a	28.86, 82 ^a	11.90, 71 ^a	3.06, 13.32 ^a	14.21, 24.66 ^a
Female	21.82, 62 ^a	17.21, 63 ^a	28.72, 92 ^a	11.51, 29 ^a	3.49, 9.11 ^a	15.99, 14.69 ^a

^aPercentile%.

Table 3. Gender Differences (T-Test for Independent Samples, 2-Tailed)

Variables	Mean ± SD	t-Value	P < 0.001 Sig. (2-Tailed)	95% Confidence Interval of the Difference	
				Lower	Upper
Height, cm		7.40	0.000 ^a	10.95	19.18
Male	178.07 ± 7.52				
Female	163.00 ± 7.14				
Weight, kg		3.62	0.001 ^a	4.70	16.08
Male	68.29 ± 10.91				
Female	57.89 ± 9.75				
BMI, kg/m²		-0.33	0.749	-2.08	1.47
Male	21.52 ± 3.06 (54 ^a)				
Female	21.82 ± 3.49 (62 ^a)				

Abbreviations: Mean, mean value; SD, Standard Deviation.

^aPercentile%.

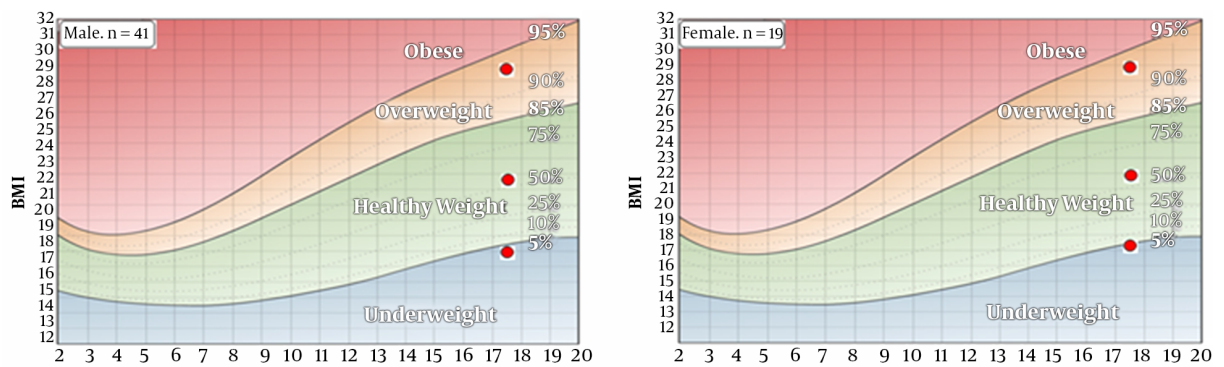


Figure 1. BMI for Male and Female Students

tance of healthy lifestyle as a means of preventing excessive obesity must be an integral part of everyday life of high

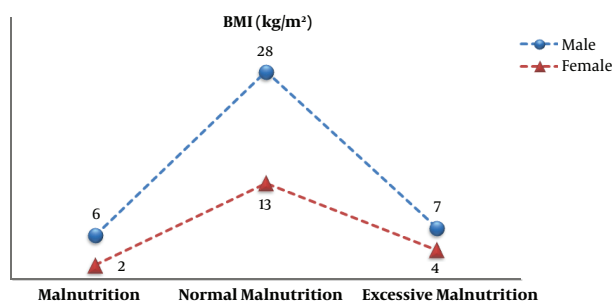


Figure 2. Trend of BMI Changes in Relation to Nutrition Status

school students for maintaining health in today's modern society.

4.1. Conclusion

The results of the current study of a sample including 60 students of both sexes, aged 17 ± 0.5 years, confirmed the differences between male and female respondents in anthropometric parameters, while no significant difference was found in the two groups. What is encouraging, however, is the fact that most of male and female students were in the normal nutrition and BMI status. All in all, the results are not too alarming, but it is important to monitor and record the changing trend of physical traits, especially those who follow the poor lifestyle.

Footnote

Conflicts of Interest: We have nothing to declare.

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