

## Differences in the nutritional status and body composition of 6<sup>th</sup> and 7<sup>th</sup> grade students in Bosnia and Herzegovina

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### Abstract

This study was conducted on a sample of 136 students (94 students from the 6th grade and 42 students from the 7th grade) with an average age of 11.56 years old. The aim of this study was to determine the degree and differences in the degree of nutrition and body composition of students from 6th and 7th grades in elementary school. Based on the obtained results, using the T-test for small independent samples, it was determined that there are statistically significant differences between students from 6th and 7th grades both in the degree of nutrition and body composition, which were estimated by 34 variables using a bioelectric impedance instrument (InBody 720). It was determined that out of the total of 94 (69.1%) students from the 6th grade, 27 of them (28.7%) had an excessive body weight; 18 (19.1%) were obese; 48 (51.1%) students from the 6th grade had a normal body weight, and 1 (1.1%) student from the 6th grade belonged to the malnourished category. Out of the total of 42 (30.9%) students from the 7th grade, 15 of them (35.7%) have an excessive body weight; 7 (16.7%) were obese; 20 (47.6%) students from the 7th grade had a normal body weight, and there were no malnourished students. On average, students from the 7th grade had higher values of the total body fluid in the body, presence of proteins, minerals, bone minerals, lean tissue, muscle mass, skeletal muscle mass, body mass index, muscle mass in left and right arms and trunk, muscle mass and its percentual representation in lower extremities, target weight, and muscle control compared to the 6th grade students. The obtained data indicate the problems that currently exist; these problems are conditioned by bad habits and lifestyle. Modern society is characterized by markedly reduced motor activity, improper diet, and an increasing number of people whose lifestyle can be described as "sedentary". It is necessary to act preventively by more frequently monitoring and analyzing proper growth and development and by motivating students to get involved in sports actively or recreationally. In most cases, proper habits that are adopted in childhood remain at other stages of development.

**Key words:** body composition; body mass index; elementary school age; health, obesity

### Introduction

The average amount of body fat at birth is approximately 13.0% of body mass; at the end of the first year, it is approximately 28.0%. In the following years, the amount of fat decreases, and a re-increase occurs at approximately the age of 12 in girls and at the age of 16–17 in boys. Gender differences in the amount of fat in the body appear in early childhood. Girls show a higher percentage of adipose tissue than boys as young as 5–6 years of age. In boys, a significant decrease is most often observed in the relative fat content between the age of 12–13 and 16–17, i.e., during puberty. During this period, boys experience a large increase in lean body mass and a consequent decrease in the relative share of fat in the total body weight. At the end of adolescence, the difference in the percentage of fat between the sexes is approximately 10.0%. From the onset of adulthood until the age of 60, the percentage of body fat increases by approximately 1.0% per decade; after the age of 60, the relative share of fat in the total body weight slightly decreases primarily owing to a decrease in adipose tissue (WHO, 1995). Adipose tissue redistributes with age and increasingly accumulates in the abdominal area (visceral fat) (Seidell&Visscher, 2000).

During the aging process, there is an increase in visceral fat, while subcutaneous fat in other parts of the body decreases owing to the redistribution of fat in the body (Zamboni et al., 2005). Therefore, the evaluation of the state of body composition is often the subject of research based on which a realistic insight is obtained into the current state of the defined population and possible negative or positive trends of growth and development over a period of time (Dopsaj et al. 2005). The effect of diet and physical activity changes the relationship between fat and non-fat mass and, thus, the composition of the body. Most methods for determining body composition are based on a two-component model (non-fat and fat mass), while some methods are based on three-component (water, non-fat, and fat mass) and four-component (water, bone minerals, proteins, and fat) models (Mišigoj-Duraković, 2008). The aging process results in an increase in adipose tissue and a decrease in

muscle mass, which in total leads to changes in body composition and shape (Krznarić et al., 2011). Owing to its simplicity and accuracy, the body mass index (BMI) is widely used to assess nutritional status. Although it does not provide information on body composition, in combination with other methods that determine body composition, information on the degree of nutrition of an individual or an observed group can be obtained (Mišigoj-Duraković et al., 2014). The most significant disorder is obesity which is more prevalent in children in adolescence. Ten years ago, statistical data showed that 10.5% of children in Croatia had increased body weight, and 3.8% of them were obese.

The latest data from CNIPH (Croatian Institute of Public Health) show that 26.4% of school-age children are overweight, while 11.2% are obese. Croatia ranks in a worrying fifth place in Europe in the number of overweight children (Kolarić&Nožinić, 2016). A large survey conducted in Greece in 2011 on 11–12-year-old children showed that 36.6% of children were overweight and obese (ŠimestinPavić, 2016). According to the World Health Organization (WHO, 2018), childhood obesity is one of the greatest global public health challenges of the 21st century. It is estimated that in the last 40 years, the number of obese school-age children and adolescents has increased by as much as tenfold. Baranowski& Taveras (2018) state that the current approach to the issue of childhood obesity has not yielded expected results and that it is necessary to strengthen preventive activities at all levels, starting with parents. Nutrition and school are related and, thus, affect the analysis of nutritional status and body composition of primary school-age students. Nutrition is no longer completely under the control of parents. Therefore, without supervision, they eat at least one meal a day or even several snacks. In addition, modern fast lifestyle affects diet; lack of time, dynamics of life, and increasing work hours of parents cause children and young people to more often consume food outside the home; they more frequently eat meals that are rich in energy but do not contain a sufficient amount of nutrients and protective substances such as vitamins and minerals (Taljić, 2019). In the research conducted using the ITOF criterion, the majority of children (i.e., 65.74%) were normally fed; as many as 21.51% were malnourished; while 7.97% of children had increased body weight, and 4.78% were obese (Paić, 2019).

## Materials and methods

### *Participants*

The research included a sample of 136 students that was divided into two subsamples, as follows. A total of 94 students were from the 6th grade with the average values for body height (BH) of  $153.06 \pm 7.66$  cm, body weight (BW) of  $46.50 \pm 10.86$ , BMI of  $19.66 \pm 3.42$  kg/m<sup>2</sup>, and chronological age of  $11.63 \pm 0.95$  years. A total of 42 students were from the 7th grade with the average values for BH of  $163.77 \pm 8.22$  cm, BW of  $56.70 \pm 10.87$  kg, BMI of  $21.06 \pm 3.35$  kg/m<sup>2</sup>, and chronological age of  $11.55 \pm 0.90$  years.

### *Sample of variables*

The sample of measuring instruments used in the research represents a set of 34 variables. To assess the anthropometric characteristics, 3 variables were used: BH, BW, and BMI. All anthropometric variables were measured according to the standard procedures of the International Society for the Advancement of Kinanthropometry (ISAK) (Marfell-Jones et al., 2006). The following variables were used to assess body composition:

- 10 variables for assessing body composition:  
total body water (TBW), proteins, minerals, body fat mass (BFM), soft lean mass (SLM), fat/non-fat tissue ratio (BFM/SLM), fat free mass (FFM), skeletal muscle mass (SMM), minerals in the bones (MB), percent body fat (PBF)
- 10 variables for the segmental display of body muscle mass:  
right arm muscle mass (FFM of right arm), right arm muscle mass percentage (% FFM of right arm), left arm muscle mass (FFM of left arm), left arm muscle mass percentage (% FFM of left arm), trunk muscle mass (FFM of trunk), trunk muscle mass percentage (% FFM of trunk), right leg muscle mass (FFM of right leg), right leg muscle mass percentage (% FFM of right leg), left leg muscle mass (FFM of left leg), left leg muscle mass percentage (% FFM of left leg)
- 10 variables for the segmental display of adipose tissue:  
right arm adipose tissue (BFM of right arm), right arm adipose tissue percentage (% BFM of right arm), left arm adipose tissue (BFM of left arm), left arm adipose tissue percentage (% BFM of left arm), trunk adipose tissue (BFM of trunk), trunk adipose tissue percentage (% BFM of trunk), right leg adipose tissue (BFM of right leg), right leg adipose tissue percentage (% BFM of right leg), left leg adipose tissue (BFM of left leg), left leg adipose tissue percentage (% BFM of left leg)
- a variable for estimating the waist-to-hip ratio (WHR).
- Body composition was measured using the InBody720 scale (Aandstad, Holtberget, Hageberg, Holme, & Anderssen, 2014).

### *Research design*

Anthropometric variables were measured according to the standard procedures of the International Society for the Advancement of Kinanthropometry (ISAK) (Marfell-Jones et al. 2006). Based on BH and BW, BMI [ $BMI = BH \text{ (kg)} / BW \text{ (cm)}^2$ ] was calculated. The BMI values for both subsamples were classified into 4

nutritional levels according to the recommendations of the Centers for Disease Control and Prevention, 2000 (Kuczmarski et al., 2000) shown in Table 1.

**Table 1.** Categorization of nutrition based on percentiles

BMI	Percentile	Weight
BMI ≥	95th percentile	Obesity
BMI =	85–95th percentile	Tendency to obesity
BMI =	5–85th percentile	Normal weight
BMI ≤	5th percentile	Malnutrition

Centers for Disease Control and Prevention, 2000 (Kuczmarski et al., 2002).

Body composition was measured using the InBody720 scale (Aandstad et al., 2014). The validity of determining the body composition of a sample of children using the InBody720 scale has been confirmed by previous studies (Lim et al., 2009; Tompuri et al., 2015). This research was approved by the Ethics Commission of the Faculty of Education, University of Sarajevo (World Medical Association, 2013). All parents were informed in advance about the implementation of the research, and the purpose and goals of this research were explained. Therefore, the research was supported by all parents, who provided a written consent.

*Statistical analysis*

All data collected by this research were processed by descriptive and comparative statistics. Using descriptive statistics, the arithmetic mean and standard deviation were calculated for each variable; for small independent samples, the T-test was used to identify differences. The statistical program for personal computers SPSS for Windows-version 20.0 was used for data processing.

**Results**

Table 2 shows the results of the basic parameters of descriptive statistics [i.e., arithmetic mean (mean), standard deviation (Std.Dev), and BMI) for students from 6th and 7th grades. Based on the obtained values, the average height of students from the 6th grade was 153.0691 cm, and the weight was 46.5074 kg. For the students from the 7th grade, the average height was 163.7786 cm, and the weight was 56.7024 kg. The average BMI value for students from the 6th grade was 19.66, and that for students from the 7th grade was 21.06.

**Table 2.** Descriptive statistics related to body height, weight of subjects, and BMI by class

Variables	Class	Mean ± Std.Dev.
Body Height (cm)	6th	153.06 ± 7.66
	7th	163.77 ± 8.22
Body Weight (kg)	6th	46.50 ± 10.86
	7th	56.70 ± 10.87
Body Mass Index (kg/m <sup>2</sup> )	6th	19.66 ± 3.42
	7th	21.06 ± 3.35

Table 3 shows the percentile values for the BMI variable, based on which it is possible to determine the nutritional status of students by grades and level of nutrition. A very high percentage of overweight and obese students is evident. By separately observing students from 6th and 7th grades, it was determined that excessive BW and obesity were more prevalent in students from the 6th grade than in students from the 7th grade; this result was expected because out of the total sample of 136 (100.0%) students, 94 (69.1%) students were from the 6th grade, and 42 (30.9%) students were from the 7th grade.

Out of the total of 94 (69.1%) students from the 6th grade, 27 (28.7%) had excessive BW, and 18 (19.1%) were obese, while 48 (51.1%) students from the 6th grade had normal BW, and 1 (1.1%) student from the 6th grade belonged to the malnourished category. Out of the total of 42 (30.9%) students from the 7th grade, 15 (35.7%) had excessive BW, 7 (16.7%) were obese, while 20 (47.6%) students from the 7th grade had normal BW, and there were no malnourished students.

**Table 3.** Nutritional status and percentiles of 6th and 7th grade students

Nutritional status	6th			7th		
	N	Percentiles	%	N	Percentiles	%
<b>Obesity</b>	18	≥95	19.1	7	≥95	16.7
<b>Overweight</b>	27	85–95	28.7	15	85–95	35.7
<b>Normal weight</b>	48	5–85	51.1	20	5–85	47.6
<b>Malnutrition</b>	1	<5	1.1	0	<5	0.0
<b>Total:</b>	94		100.0	42		100.0

By analyzing the results shown in Table 4, it is determined that there are differences in body composition indicators between 6th and 7th grade students. However, because these differences can only reflect random variations in the sample, their significance was examined using a T-test for small independent samples.

The analysis of T-test results shows that there are statistically significant differences in the number of body composition indicators. Only differences in adipose tissue, body fat percentage, and adipose-to-non-adipose tissue ratio were not identified. Therefore, it can be concluded that, on average, the 7th grade students have significantly higher values of total body fluid, proteins, minerals, bone minerals, lean tissue, muscle mass, skeletal muscle mass, and BMI.

**Table 4.** Differences in the body composition between 6th and 7th grade students – descriptive statistics, T-test

Variables	Class	Mean ± Std.Dev.	T-test	
			t-value	P
TBW	6th	25.35 ± 4.30	-6.537	<b>0.00 **</b>
	7th	31.40 ± 6.26		
Proteins	6th	6.77 ± 1.15	-6.669	<b>0.00 **</b>
	7th	8.43 ± 1.70		
Minerals	6th	2.43 ± 0.44	-6.827	<b>0.00 **</b>
	7th	3.04 ± 0.57		
BFM	6th	11.95 ± 6.54	-1.512	0.133
	7th	13.83 ± 7.04		
SLM	6th	32.54 ± 5.53	-6.544	<b>0.00 **</b>
	7th	40.33 ± 8.05		
Ratio BFM/SLM	6th	0.36 ± 0.17	0.072	0.943
	7th	0.35 ± 0.19		
FFM	6th	34.45 ± 5.90	-6.663	<b>0.00 **</b>
	7th	42.87 ± 8.52		
SMM	6th	18.41 ± 3.50	-6.572	<b>0.00 **</b>
	7th	23.38 ± 5.14		
MB	6th	2.02 ± 0.37	-6.750	<b>0.00 **</b>
	7th	2.53 ± 0.47		
PBF	6th	24.37 ± 8.65	0.302	0.763
	7th	23.87 ± 9.81		

p-level of significance, \*\* T-test is statistically significant at less than 1%

By analyzing the results shown in Table 5, it is determined that most absolute values related to muscle mass are higher for the 7th grade students, while a significant part of the values related to the percentage of muscle mass is higher for the 6th grade students, which is an interesting result. However, to examine the significance of these differences, the T-test for independent samples was used. Statistically significant T-tests were used for the absolute values of the muscle mass variables of the left and right arm and the torso but not to the percentage representation of muscle mass in these parts of the body. The exceptions are the left and right legs, where significant differences were observed in both the raw values and percentage. On average, compared to the 6th grade students, the 7th grade students had significantly higher values of muscle mass of the left and right arm and the torso, and had significantly higher values of muscle mass and its percentage in both lower extremities.

**Table 5.** Differences in the representation of muscle mass between 6th and 7th gradestudents – descriptive statistics, T-test

Variables	Class	Mean ± Std.Dev.	T-test	
			t-value	P
FFM of Right Arm	6th	1.51 ± 0.38	-6.236	<b>0.00 **</b>
	7th	2.04 ± 0.57		
% FFM of Right Arm	6th	93.24 ± 16.74	0.883	0.379
	7th	90.61 ± 14.38		
FFM of Left Arm	6th	14.38 ± 0.39	-5.846	<b>0.00 **</b>
	7th	1.99 ± 0.56		
% FFM of Left Arm	6th	91.30 ± 17.65	1.145	0.254
	7th	87.68 ± 15.55		
FFM of Trunk	6th	14.96 ± 2.63	-6.402	<b>0.00 **</b>
	7th	18.45 ± 3.51		
% FFM of Trunk	6th	99.41 ± 7.56	1.383	0.169
	7th	97.41 ± 8.27		
FFM of Right Leg	6th	5.12 ± 1.16	-6.529	<b>0.00 **</b>
	7th	6.71 ± 1.60		
% FFM of Right Leg	6th	97.00 ± 9.04	-2.146	0.034 *
	7th	100.81 ± 10.65		
FFM of Left Leg	6th	5.07 ± 1.10	-6.825	<b>0.00 **</b>
	7th	6.68 ± 1.57		
% FFM of Left Leg	6th	96.65 ± 9.11	-2.173	0.032 *
	7th	100.51 ± 10.53		

p-level of significance, \* The T-test is statistically significant at the level of less than 5%, \*\* The T-test is statistically significant at the level of less than 1%

By analyzing the results shown in Table 6, it is determined that for all body parts, on average, 7th grade students have higher raw adipose tissue values but a lower percentage of adipose tissue compared to 6th grade students. The significance of these differences was examined using the T-test. None of the T-tests are statistically significant, which means that differences in adipose tissue representation between 7th and 6th grade students reflect only random variations.

**Table 6.** Differences in the representation of adipose tissue in the body between the students from 6th and 7th grades – descriptive statistics, T-test

Variables	Class	Mean ± Std.Dev.	T-test	
			t-value	P
BFM of Right Arm	6th	0.85 ± 0.52	-0.820	0.414
	7th	0.93 ± 0.57		
% BFM of Right Arm	6th	32.67 ± 10.14	1.712	0.089
	7th	29.13 ± 13.12		
BFM of Left Arm	6th	0.85 ± 0.48	-1.107	0.270
	7th	0.95 ± 0.56		
% BFM of Left Arm	6th	33.03 ± 9.87	1.498	0.136
	7th	30.01 ± 12.89		
BFM of Trunk	6th	5.38 ± 3.66	-1.636	0.104
	7th	6.51 ± 3.87		
% BFM of Trunk	6th	22.92 ± 11.03	-0.384	0.701
	7th	23.71 ± 10.96		
BFM of Right Leg	6th	1.97 ± 0.89	-1.494	0.138
	7th	2.23 ± 0.98		
% BFM of Right Leg	6th	26.05 ± 7.34	1.453	0.148
	7th	23.92 ± 9.04		
BFM of Left Leg	6th	1.97 ± 0.89	-1.484	0.140
	7th	2.22 ± 0.97		
% BFM of Left Leg	6th	26.06 ± 7.33	1.457	0.148
	7th	23.92 ± 9.08		

p-level of significance

By analyzing the results shown in Table 7, differences between the students from 6th and 7th grades in the values of the ratio of waist and hip circumference variables were observed, and their significance was further examined using the T-test. Differences between 6th and 7th grade students in the values of the waist-to-hip ratio variables are not statistically significant and reflect only random variations.

**Table 7.** Differences in the values of the parameters of the ratio of waist circumference and hips between the students from 6th and 7th grades – descriptive statistics, T-test

Variables	Class	Mean ± Std.Dev.	T-test	
			t-value	P
WHR	6th	0.82 ± 0.04	-0.960	0.009
	7th	0.82 ± 0.05		

p-level of significance

### Discussion

The results of this study show that almost half of the students in 6th and 7th grades have excessive BW and are obese. Excessive BW and obesity are more prevalent in the 6th grade students than in the 7th grade students. This is expected because out of the total sample of 136 (100.0%) students, 94 (69.1%) students are from the 6th grade, and 42 (30.9%) students are from the 7th grade. Based on the T-test results, it can be concluded that there are statistically significant differences in the number of body composition indicators between the students from 6th and 7th grades. Only differences in adipose tissue, body fat percentage, and adipose-to-non-adipose tissue ratio are not identified. On average, the 7th grade students have significantly higher values of the total body fluid, proteins, minerals, bone minerals, lean tissue, muscle mass, skeletal muscle mass, and BMI. Most of the absolute values related to muscle mass are higher for the 7th grade students, while most values related to the percentage of muscle mass are higher for the 6th grade students. Statistically significant T-tests refer to the absolute values of the muscle mass variables of the left and right arm as well as the torso but not to the percentage representation of muscle mass in these parts of the body.

The exceptions are the left and right legs, where significant differences are observed both in the "raw" values and in the percentage. On average, the 7th grade students have significantly higher values of muscle mass of the left and right arm and torso compared to the 6th grade students and have significantly higher values of muscle mass and its percentage in both lower extremities. For all parts of the body, on average, the 7th grade students have higher "raw" values of adipose tissue but a lower percentage of adipose tissue compared to the 6th grade students. Based on a series of analyses, it is determined that there are statistically significant differences between 6th and 7th grade students in many variables related to body composition and nutritional status.

Durković (2012) indicates that in addition to affecting a person's health status, obesity affects work productivity and financial expenditures for treating overweight and obese people. If this period of intensive growth and development is not based on healthy habits, the risk of developing various diseases, both in youth and adulthood, is inevitable. In our country, as in the region overall, every third child spends three to five hours a day in front of a computer or TV, which considerably affects weight gain (Despotović, Alexopoulos, Despotović, & Ilić, 2013). The study on a sample of 11–14-year-old respondents indicates that only 62% of students are properly fed, while 33% fall into the category of overweight, and 5% are obese. These results indicate a significant and worrying relative increase in body weight and obesity in this age group (Podnar et al., 2013). The human body contains approximately 19.5% of protein, 1–2% of glycogen, 8% of minerals, and 72.5% of water, where approximately 50% is extracellular water (WHO, 1995).

The composition of the human body can be divided into two components, i.e., fat (adipose) and non-fat mass. Fat mass is considered metabolically inactive; however, it is essential for hormone metabolism and adiponectin levels. Fat mass is heterogeneous and extremely metabolically active because it encompasses bone, muscle tissue, extracellular water, nerve tissue, various organs, and all cells except adipocytes (Willett, 2013). Childhood obesity increases the risk of adulthood obesity and is associated with a range of comorbidities such as type 2 diabetes, hypertension, nonalcoholic fatty liver, and respiratory distress. Children are exposed to stigmatization and have poorer socioeconomic status and consequently poorer quality of life and lower life expectancy (Sahoo et al., 2015). The level of child nutrition in Sarajevo Canton shows that 78.10% of children have normal nutrition, 12.30% are overfed, 7.10% are obese, and 2.50% are malnourished (Taljić and Nikšić, 2016). The Croatian Health Statistics Yearbook issued every year by the Croatian Institute of Public Health and the data collected from the County Institutes of Public Health and the Institute of Public Health of the City of Zagreb obtained from the School Medicine Services showed that 3.73% of students at primary schools were malnourished, 12.85% were overweight, and 17.74% were obese. If we exclude children with normal body weight, 34.32% of primary school children are in other categories (Puharić et al., 2016).

The results of the survey of BMI of children in the Sarajevo Canton in 2016 showed that there were a total of 3548 respondents from the 6th grade, of which 1708 were girls and 1840 were boys. Out of the total number of 6th grade respondents included in this study, most respondents had normal BW, i.e., 912 (53.4%) girls and 852 (46.3%) boys. By separately evaluating the 6th grade subjects by gender, excessive BW and obesity were more prevalent in boys. More specifically, out of the total of 1840 boys, 424 (23.0%) were overweight and 405 (22.0%) were obese; while, out of the total of 1708 girls, 395 (23.1%) were overweight, and 226 (13.2%) were obese. The study on the BMI of children from the 7th grade included a total of 3469 respondents, of which 1675 were girls and 1794 were boys. Out of the total number of 7th grade respondents included in this study, most of the respondents had normal BW, i.e., 935 (55.8%) girls and 882 (49.2%) boys. In terms of the 7th grade respondents by gender, excessive BW and obesity were more prevalent in boys. More specifically, out of the total of 1794 boys, 399 (22.2%) were overweight, and 358 (20.0%) were obese; while out of the total of 1675 girls, 361 (21.6%) were overweight, and 201 (12.0%) were obese (Abazović et al., 2016).

When comparing the results of the percentage of BMI by grades (i.e., 1st, 3rd, 5th, and 7th) and categories for girls and boys at primary schools in Sarajevo Canton and primary schools in the City of Mostar, it is determined that in Sarajevo Canton there are more children with lower BMI than normal, and the highest BMI is observed in 10.3% of children from the 1st grade; while in the City of Mostar, this percentage is highest in the 7th grade and amounts to 8.0%. In addition, the highest percentage of children with increased BMI in Sarajevo Canton and the City of Mostar is in the 5th grade and amounts to 44.6% for Sarajevo Canton and 43.1% for the City of Mostar. When we take into account all of the results of the research conducted in Sarajevo Canton and in the City of Mostar, we can conclude that somewhat more favorable results were obtained for the City of Mostar, and that the most similar results for Sarajevo Canton and the City of Mostar are those recorded for the 5th grade students (Abazović et al., 2016; Čolakhodžić et al., 2017). A large study conducted on the sample of 11–12-year-old respondents shows that 36.6% of children are overweight and obese (ŠimestinPavić, 2016). According to the World Health Organization (WHO, 2018), childhood obesity is one of the greatest global public health challenges of the 21st century. It is estimated that in the last 40 years, the number of obese school-age children and adolescents has increased by as much as tenfold (WHO, 2018).

The etiology of childhood obesity is very complex; however, eating and living habits are essential (Kumar and Kelly, 2017). By evaluating the general results of the study (in which a total of 1940 students participated) performed to evaluate obesity in primary school children in the City of Mostar, an extremely large number of children with increased body weight was recorded. Of the total number of students included in this study, as many as 36.4% (707) were obese, while 56.1% of children had normal body weight. In addition, 7.4% (144) of respondents was malnourished. According to the obtained results, almost every other child has an eating disorder (43.9%), which is extremely alarming (Čolakhodžić et al., 2017).

Although BMI does not show body composition, and thus the proportion of fat that determines obesity (MišigojDuraković et al., 2014), the results of the nutritional status of most respondents indicate obesity; in addition, in the analysis of body composition, there is a very high proportion of adipose tissue. Specifically, the comparison of BMI values with the percentage of adipose tissue shows a positive correlation for both sexes. The strong association of BMI with adipose tissue indicates that subjects with a higher BMI also have a higher

proportion of adipose tissue. Similar research (Akindele et al., 2016) also confirms the knowledge approximately the interrelationship between BMI and adipose tissue content. Puberty is a succession of anatomical and physiological changes in early adolescence that mark the transition period from sexually immature to fully mature and are characterized by the development of reproductive functions, changes in body size, composition, and function in response to sex hormones (Perroni et al., 2018).

In a study conducted on the sample of 136 students (67 boys and 69 girls), with an average age of 11.56 years, the aim was to determine the degree and differences in the degree of nutrition and body composition in boys and girls of pubertal age. Based on the obtained results of the T-test for small independent samples, it was determined that there were no statistically significant differences between boys and girls both in the degree of nutrition and in body composition, which was assessed by 10 variables using bioelectric impedance InBody 720. A total of 19.70% of boys were obese as well as 17.40% of girls. Collectively, based on the percentage of malnourished respondents, a total of 61.50% of boys and 37.70% of girls were not normally fed (Nikšić et al., 2021).

### Conclusion

Based on the data indicating that 50% of respondents are overweight or obese, it can be concluded that currently this is the major problem, which indicates a need for an urgent solution to this health problem through more frequent monitoring and analysis of students, their proper growth and development, including social communities in problem solving and motivating students for more frequent involvement in various sports activities. As with nutrition, parents are the ones who form clear habits for movement, play, sports, watching television, and computer games. Habits that are adopted in childhood, in most cases, remain in other developmental stages.

With proper nutrition and regular physical activity, we maintain good health throughout life. Proper nutrition in children is especially important. Nutrition greatly affects the health of every individual throughout life especially in school-age children because by meeting basic energy needs and adequate nutrient intake, a well-balanced and proper diet ensures proper growth and development. Food provides nutrients that are necessary for building tissues (proteins, iron, and calcium), energy for metabolism and physical activity (fats and carbohydrates) and nutrients needed for physiological functions of the body (vitamins and minerals). A healthy and proper diet provides good results and successful work of "small gray brain cells" that need to store a lot of information throughout the years of life.

To have a balanced and varied diet, it is essential to adopt proper eating habits from parents in early childhood and continue to nurture them throughout life. Young people at the age of 11 need to be provided with an amount of food that will meet the needs of the organism in terms of energy and nutrition (growth and development) and enable the smooth performance of all daily activities (learning, playing, resting, and sleeping). Eating problems are common and serious in all age groups. Unfortunately, more and more young people are suffering from various diseases that are caused or worsened by inadequate nutrition. School doctors and psychologists tend to immediately organize exercises to correct anomalies when correcting irregularities in the posture of children, visual, or speech disorders; however, for issues with increased body weight or malnutrition, school doctors and psychologists leave it to parents to worry about that or do pay considerable attention to it. The level of nutrition is one of the indicators of the condition of the organism. To maintain it in normal values, it is necessary to consume various foods, divide daily meals into five smaller ones, and adhere to the guidelines of proper nutrition. It is necessary to consume approximately 2 L of fluid and engage in regular physical activity. Daily energy intake by the body should be equivalent to its consumption through daily activities.

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### References

- Aandstad, A., Holtberget, K., Hageberg, R., Holme, I., Anderssen, SA. (2014). Validity and reliability of bioelectrical impedance analysis and skinfold thickness in predicting body fat in military personnel. *Military Medicine*, 179(2): 208- 217. <https://doi.org/10.7205/MILMED-D-12-00545>
- Abazović, E., Hasanbegović, S., Kovačević, E., Okanović, I., Kazazović, E., Ademaj, Z., Lakota, R., Mekić, A. (2016). *Pretilost djece osnovnih škola Kantona Sarajeva: Prikaz rezultata istraživanja provedenog na 33 200 djece* [Obesity of primary school children in Sarajevo Canton: Review of the results of a study conducted on 33,200 children]. Ministry of Education, Science and Youth of Sarajevo Canton; Ministry of Health of Sarajevo Canton, Sarajevo.
- Akindele, MO., Phillips, JS., Igumbor, EU. (2016). The relationship between body fat percentage and body mass index in overweight and obese individuals in an urban african setting. *Journal of Public Health in Africa*, 7 (1): 515. doi: [10.4081/jphia.2016.515](https://doi.org/10.4081/jphia.2016.515)



- Baranowski, T., Taveras, EM. (2018). Childhood Obesity Prevention: Changing the focus. *Chilhood Obesity*, 14(1): 1-3. <https://doi.org/10.1089/chi.2017.0303>
- Čolakhodžić, E., Vuk, N., Habul, Č., Vujica, S., Tanović, S. (2017). *Pretilostiposturalni status dječeosnovnoškolskoguzrasta u GraduMostaru* [Obesity and postural status of primary school children in the City of Mostar]. City of Mostar, DžemalBijedić University in Mostar, Faculty of Teacher Education, Mostar.
- Despotović, M., Alekxopulos, H., Despotović, M., Ilić, B. (2013). Stanje uhranjenosti dece predškolskoguzrasta [Nutritional status of preschool children]. *Medicinski časopis*, 47(2): 62-68. (In Serbian).
- Dopsaj, M., Milošević, M., Vučković, G., Blagojević, M., Mudrić, R. (2005). Dijagnostika stanja indeksa telesne mase studenata Policijske akademije [Diagnostics of the body mass index of students of the Police Academy]. *Sportska Medicina*, 5(4): 180-191. (In Serbian)
- Durković, M. (2012). Gojaznost kao politički i teorijski problem [Obesity as a political and theoretical problem]. *Medicinski glasnik*, 44(17): 32-49. (In Serbian). [doi: 10.5937/medgla1244032D](https://doi.org/10.5937/medgla1244032D)
- Krznarić, Ž., Vranešić Bender, D., Kelečić-Ljubas, D., Reiner, Ž., Roksandić-Tomek, S., Kekez, D., Pavić, T. (2011). Hrvatske smjernice za prehranu osobastarijediobi, Dio II - Klinička prehrana [Croatian guidelines for the nutrition of the elderly, Part II - Clinical nutrition]. *Liječnički Vjesnik: glasilo Hrvatskog liječničkog zbora*, 133(9-10): 299-307. (In Croatian)
- Kuczmarski, R., Kuczmarski, MF., Roche, AF. 2000 CDC Growth Charts: Background for Clinical Application. *Top Clin Nutr*. 2002; 17(2): 15- 26. <https://doi.org/10.1097/00008486-200203000-00006>
- Kolarić, T., Nožinić, D. (2016). Pretilost - lošena vike i stil života današnjice [Obesity - bad habits or lifestyle of today], Split: *Hrvatska proljetna pedijatrijska škola*. (In Croatian)
- Kumar, MD., Kelly, AS. (2017). Review of Childhood Obesity: From Epidemiology, Etiology, and Comorbidities to Clinical Assessment and Treatment. *Mayo Clinical Proceedings*, 92(2): 251-265. <https://doi.org/10.1016/j.mayocp.2016.09.017>
- Lim, JS., Hwang, JS., Lee, JA., Kim, DH., Park, KD., Jeong, JS., et al. (2009). Cross-calibration of multi-frequency bioelectrical impedance analysis with eight-point tactile electrodes and dual-energy X-ray absorptiometry for assessment of body composition in healthy children aged 6-18 years. *Pediatrics International*, 51: 263-8. <https://doi.org/10.1111/j.1442-200X.2008.02698.x>
- Marfell-Jones, M, Olds, T, Stew, A, Carter, L. (2006). *International Standards for Anthropometric Assessment*. Australia: The International Society for the Advancement of Kinanthropometry. <https://doi.org/10.4324/9780203970157>
- Mišigoj-Duraković, M. (2008). *Kinanthropologija: biološki aspekti tjelesnog vježbanja* [Kinanthropology: biological aspects of physical exercise]. Zagreb: Faculty of Kinesiology, University of Zagreb.
- Mišigoj-Duraković, M., Sorić, M., Duraković, Z. (2014). Antropometrija u procjeni kardio-metaboličkog rizika [Anthropometry in cardio-metabolic risk assessment]. *Arhiv za higijenu rada i toksikologiju*, 65(1): 19-26. <https://doi.org/10.2478/10004-1254-65-2014-2381>
- Nikšić, E., Joksimović, M., Beganović, E., Gardašević, N. (2021). Differences in the degree of nutrition and body composition of boys and girls of pubertal age. *Pedagogy of Physical Culture and Sports*, 25(1): 4-9. <https://doi.org/10.15561/26649837.2021.0101>
- Paić, A. (2019). Utjecaj roditelja na stanje uhranjenosti i prehrane i životne navike dječestarosti 7 godina [The influence of parents on the state of nutrition and eating and living habits of children aged 7 years]. [In Serbian]. Osijek: Specialist paper, Josip Juraj Strossmayer University of Osijek, Faculty of Food Technology. (In Serbian).
- Perroni, F., Pintus, A., Frandino, M., Guidetti, L., Baldari, C. (2018). Relationship Among Repeated Sprint Ability, Chronological Age, and Puberty in Young Soccer Players. *Journal of Strength and Conditioning Research*, 32(2): 364-371. <https://doi.org/10.1519/JSC.0000000000001799>
- Podnar, H., Čule, M., Šafarić, Z. (2013). Dijagnostika stanja uhranjenosti učenika osnovnih škola grada Zagreba [Diagnosis of nutritional status of primary school students in the city of Zagreb]. *22. ljetna škola kineziologa Republike Hrvatske*, Zagreb, Hrvatski kineziološki savez, 522-527. (In Croatian)
- Puharić, Z., Rafaj, G., Čačić Kenjerić, D. (2015). [Nutrition and possible preventable factors influencing the nutrition of fifth grade students in the Bjelovar-Bilogora County]. *Acta medica Croatica*, 69(5): 439-450. Taken from <https://hrcak.srce.hr/154194>
- Sahoo, K., Sahoo, B., Choudhury, AK, Sofi, NY, Kumar, R., Bhadoria, AS. (2015). Childhood obesity: causes and consequences. *Journal of Family Medicine Primary Care* 4(2): 187-192. [doi: 10.4103/2249-4863.154628](https://doi.org/10.4103/2249-4863.154628)
- Seidell, JC., Visscher, TL. (2000). Body weight and weight change and their health implications for the elderly. *European Journal of Clinical Nutrition*, 54(3): S33-9. <https://doi.org/10.1038/sj.ejcn.1601023>
- Šimestin Pavić, I., Mayer, D., Musić Milanović, S., Pejnović Franelić, I., Jovičić, D. (2016). Croatian Institute of Public Health. Research on student health behavior. [Basic indicators of health and well-being of male and female students in Croatia in 2013/2014.] Zagreb, 1/58.



- Taljić I., Nikšić E. (2016). Impact of food habits to BMI category of adolescent boys, *18<sup>th</sup> Danube-Kris-Mures-Tisza (DKMT) Euroregion Conference on Environment and Health*, University of Novi Sad, Faculty of Technology Novi Sad, Serbia. pp:26.
- Taljić, I. (2019). *Ishranaškolskedjeceiadolescenata* [Nutrition of school children and adolescents]. Sarajevo: University of Sarajevo, Center for Interdisciplinary Studies. (In Serbian).
- Tompuri, TT., Lakka, TA., Hakulinen, M., Lindi, V., Laaksonen, DE., Kilpeläinen, TO., et al. (2015). Assessment of body composition by dual-energy X-ray absorptiometry, bioimpedance analysis and anthropometrics in children: the Physical Activity and Nutrition in Children study. *ClinPhysiolFunct Imaging*, 35: 21–33. <https://doi.org/10.1111/cpf.12118>
- Zamboni, M., Mazzali, G., Zoico, E., Harris, TB., Meigs, JB., Di Francesco, V., Fantin, F., Bissoli, L., Bosello, O. (2005). Health consequences of obesity in the elderly: a review of four unresolved questions. *International Journal of Obesity*, 29(9): 1011-1029. <https://doi.org/10.1038/sj.ijo.0803005>
- Willett, W. (2013). *Nutritional epidemiology-3rd ed.* Oxford University Press, New York.
- World Health Organization - WHO (1995). *Physical status: the use and interpretation of anthropometry Report of a WHO Expert Committee*. WHO Technical Report Series 854. Geneva: WHO.
- World Medical Association. World Medical Association Declaration of Helsinki Ethical Principles for Medical Research Involving Human Subjects. *JAMA*, 310(20): 2191-2194. doi:10.1001/jama.2013.281053
- WOF/WHO, World Obesity Federation and World Health Organization (2018). *Taking Action on Childhood Obesity Report*. World Health Organization.