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Nutritional status and gender differences of adolescent students

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Abstract:

Modern world is characterized by minimal physical activity (which is mainly reduced to the level of performing the most necessary life needs) and obesity (which has reached epidemiological characteristics). Thus, to prevent obesity and preserve human health at an early school age, it is necessary to monitor the nutritional status of children of primary school age. The aim of this study was to define the level of nutrition of the respondents and to determine the differences in body height (BH), body weight (BW), and body mass index (BMI) between the respondents in relation to gender. The sample included 105 boys and 97 girls (13.59 ± 0.30 years old), who were 8th grade students at a primary school. Three variables were analyzed, i.e., BMI, BH, and BW of the subjects. The obtained BMI values were compared with reference percentile curves (WHO, 2007), and it was determined that 34.28% of boys and 37.11% of girls were overweight (overweight and obese). Using the t-test for independent samples, it was determined that there was a statistically significant difference between boys and girls in BW and BMI. The obtained results indicated that girls had a higher percentage of BW and BMI. On average, girls were 4.53 kg heavier than boys, while BMI differed by 1.02. The difference in BH was not defined at a statistically significant level. Malnutrition and obesity are prevalent in children of pubertal age in Montenegro, which requires concrete preventive measures to preserve health at an early age.

Key words: Overweightness, obesity, BMI, primary school children

Introduction

Modern world is characterized by minimal physical activity (which is mainly reduced to the level of performing the most necessary life needs) and obesity (which has reached epidemiological characteristics). In terms of obesity, Gavin, Dowshen, & Izenberg (2007) clearly states that we are the fattest generation in the history of mankind, where the number of obese people is still alarmingly increasing. Being overweight or out of shape is often the cause of serious social and mental problems. Given the extent of the global obesity epidemic, impact on an individual's health, and cost to health care systems and global economies, it is important to identify obesity-related comorbidities in childhood to aid early identification and treatment (Sharma et al., 2019). Most overweight or obese children have cardiometabolic co-morbidities; 70% have at least 1 biochemical or clinical cardiovascular risk factor; 52% have at least 2, and 12% have 3 or more risk factors (Blüher et al., 2013). Obesity is a condition that is characterized by excess body fat, which can endanger health (Salzer, Trna, & Sučić, 2006). For several decades, obesity was usually a characteristic of adults; while today it is prevalent among children. A study by De Onis, Blössner, & Borghi (2010) showed that there were 43 million obese children in the world in 2010, of which 35 million were children in developing countries.

The authors determined that the percentage of childhood obesity increased from 4.2% in 1990 to 6.7% in 2010, while the projections for 2020 were 9.1%, or approximately 60 million children. Currently, it is difficult to talk about the percentage of obese children in the world because these figures significantly change from day to day, and there are even significant differences between respondents in the same country depending on the geographical area and place of residence. A constant decline in the level of physical activity of children on a global level can be reported from the age when they start school (Tremblay, Gonzales, Katzmarzyk, Onywera, & Reilly, 2015). Thus, to prevent obesity and preserve human health at an early school age, it is necessary to monitor the nutritional status of children of primary school age. Children who are obese or have increased body weight (BW) are more prone to reduced physical activity, or reduced physical activity is the cause of weight gain (Planinsec & Matejek, 2004). In line with the recognized problem of malnutrition among school-age children, interest in the analysis of this issue has been growing in Montenegro only in the last ten years (Martinović et al., 2015; Jakšić et al., 2019; Milašinović, Bojanić, Čvorović, & Kukić, 2019; Đorđević, Kujundžić, & Bajić, 2020,

Gardašević, Anđelić, Joksimović, & Ahmedov, 2020). To determine the state of nutrition, the body mass index (BMI) is frequently used; BMI is readily calculated using the following formula: $BMI = \text{weight (kg)} / [\text{height (m)}]^2$. The use of BMI is also accepted by the World Health Organization (WHO). In children, the results obtained by determining BMI are compared with percentile curves that take into account gender and age and thus more reliably define the nutritional status of subjects younger than 20 years of age. In practice, various percentile curves exist, on the basis of which the classification of children's nutrition is performed. Among various percentile curves, the percentile curves of WHO, Centers for Disease Control and Prevention (CDC), and International Obesity Task Force (IOTF) are most often used. Of note, for the same sample of respondents, we can obtain different results on the level of nutrition depending on the application of percentile curves, which was the case in an earlier study (Jakšić et al., 2017) on a sample of students in Montenegro. In the absence of their own percentile curves that define nutritional status, developing countries use percentile curves prescribed by relevant institutions such as WHO, CDC, and IOTF. The aim of this study is to define the nutritional level of the respondents and to determine gender differences in body height (BH), BW, and BMI between the respondents.

Materials and Methods

Participants

This study was performed on a numerically fairly uniform sample of 202 respondents (105 boys and 97 girls), with an average age of 13.59 ± 0.30 years, drawn from the population of 8th grade primary school students in Montenegro. The following variables were analyzed: BH, BW, and BMI.

Procedure

Measurement of BH (cm) and BW (kg) was performed in the gym of the school attended by students included in the sample. The measurement was performed according to the recommendations of the International Society for the Advancement of Kinanthropometry (Marfell-Jones, Olds, Stew, & Carter, 2006). To determine the level of nutrition for each subject based on age and sex, the obtained BMI values for each subject were compared with standardized tabular values recommended by WHO (2007).

To respect the ethical principles of this study, a written consent of the school administration for conducting the measurements was provided, and the consent of the parents of the students was also obtained. Data collection was performed by two authors with the help of active physical education teachers of the included school. The measurements were performed during the second week of the second semester of the school year 2019/20 in the period from February 3 to 7, 2020.

Statistical analysis

Data were processed using the Statistical Package for Social Sciences SPSS (v20.0, SPSS Inc., Chicago, IL, USA). The basic descriptive indicators of the variables were calculated: arithmetic mean (M), standard deviation (SD), minimum (Min) and maximum (Max) scores, as well as the range of scores. The normality of the distribution of results was tested using the Kolmogorov-Smirnov (K-S) test. To determine the differences in the analyzed variables between the subjects classified according to gender, the t-test for independent samples was applied.

Results

According to the primary goal of determining the level of nutrition, for all subjects, the comparison of BMI with percentile curves prescribed by WHO for 5–19-year-old subjects was performed (WHO, 2007). Table 1 and Figures 1 and 2 show the results related to the level of nutrition of boys and girls, who are students of the 8th grade at a primary school in Montenegro.

Table 1. Results of nutrition levels

Nutrition level scale according to WHO (2007)			Boys		Girls	
			N	%	N	%
BMI >	97th percentile	Obese	13	12,38	12	12,37
BMI ≤	85-97th percentile	Overweight	23	21,90	24	24,74
BMI ≤	15-85th percentile	Normal	59	56,20	52	53,61
BMI ≤	0-15th percentile	Severe thinness-	10	9,52	9	9,28
		thinness	105	100%	97	100%

Based on the results shown in Table 1, an almost identical percentage of obese boys (12.38%) and girls (12.37%) is evident. In addition, similar results were obtained for other parameters that represent the nutrition of the respondents, especially in the degree related to malnutrition of students (9.52% of boys and 9.28% of girls). The results in Table 1 and Figure 1 and 2 indicate a slightly higher percentage of malnourished girls (24.74%) compared to boys (21.90%) as well as a higher percentage of normally fed boys (56.20%) compared to girls (53.61%).

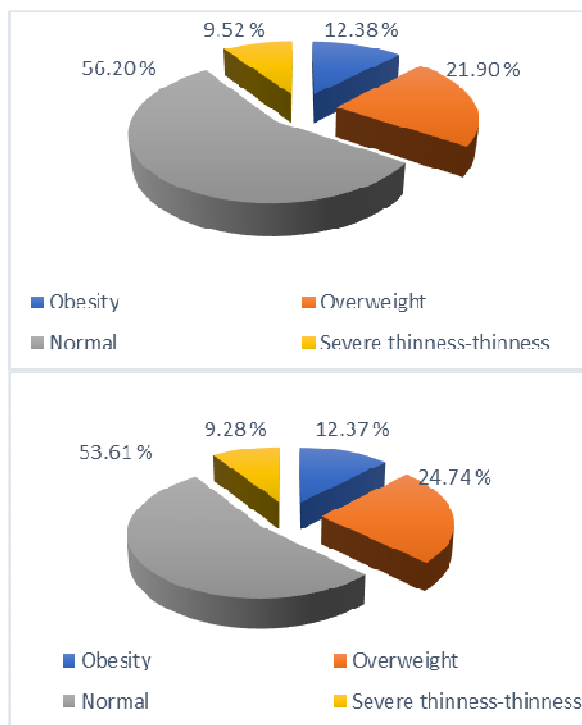


Figure 1. Nutritional status of boys

Figure 2. Nutritional status of girls

Table 2 shows the results of descriptive statistics for all variables in both subsamples as well as the results of the K-S test based on which the normality of the distribution of results was estimated. Accordingly, the values of the K-S test are not at a statistically significant level ($p \leq 0.05$). It is concluded that the distribution of results in all variables is normal and that the parametric statistical procedure (t-test for independent samples) can determine possible differences in variables between subsamples.

Table 2. Descriptive statistics for boys and girls

Variables	N	Boys			K-S (p)
		Mean±Std. Dev.	Range Min-Max		
BH (cm)	105	166.15±7.15	149.00-182.00		0.07
BW (kg)	105	56.94±11.06	39.00-95.00		0.18
BMI (kg/m ²)	105	20.61±3.61	13.80-32.60		0.12
Girls					
BH (cm)	97	168.01±9.11	151.00-189.00		0.09
BW (kg)	97	61.47±13.38	36.00-90.00		0.21
BMI (kg/m ²)	97	21.63±3.71	15.00-31.20		0.14

Table 3 shows the results of the t-test for independent samples. Differences were determined at a statistically significant level between subjects in relation to gender in variable BW and variable BMI. Girls were on average 4.53 kg heavier than boys, while the difference in BMI was 1.02 (i.e., girls had higher BMI). Since the differences in the variables between the subsamples are at a statistically significant level ($p \leq 0.05$), we can assume that the differences are similar at the level of the population of 8th grade students in Montenegro, i.e., the differences are not random.

Table 3. Differences between boys and girls

Variables	Gender	Mean±Std. Dev.	t-value	p	95% CI	
					Lower	Upper
BH (cm)	Male	166.15±7.15	-1.62	0.10	-4.12	0.40
	Female	168.01±9.11				
BW (kg)	Male	56.94±11.06	-2.62	0.00	-7.92	-1.13
	Female	61.47±13.38				
BMI (kg/m ²)	Male	20.61±3.61	-1.98	0.04	-2.04	-0.00
	Female	21.63±3.71				

Although Table 2 clearly shows that girls, who are students of the 8th grade in Montenegro, are on average taller than boys by almost 2 cm, this difference is not determined at a statistically significant level. The results of differences between the respondents in the analyzed variables are also shown in Figure 3. It is clearly observed that the values obtained for all variables are higher in girls.

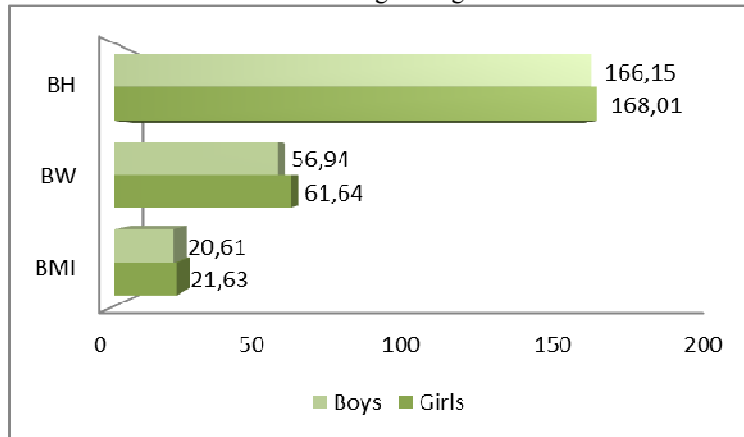


Figure 3. Differences in analyzed variables

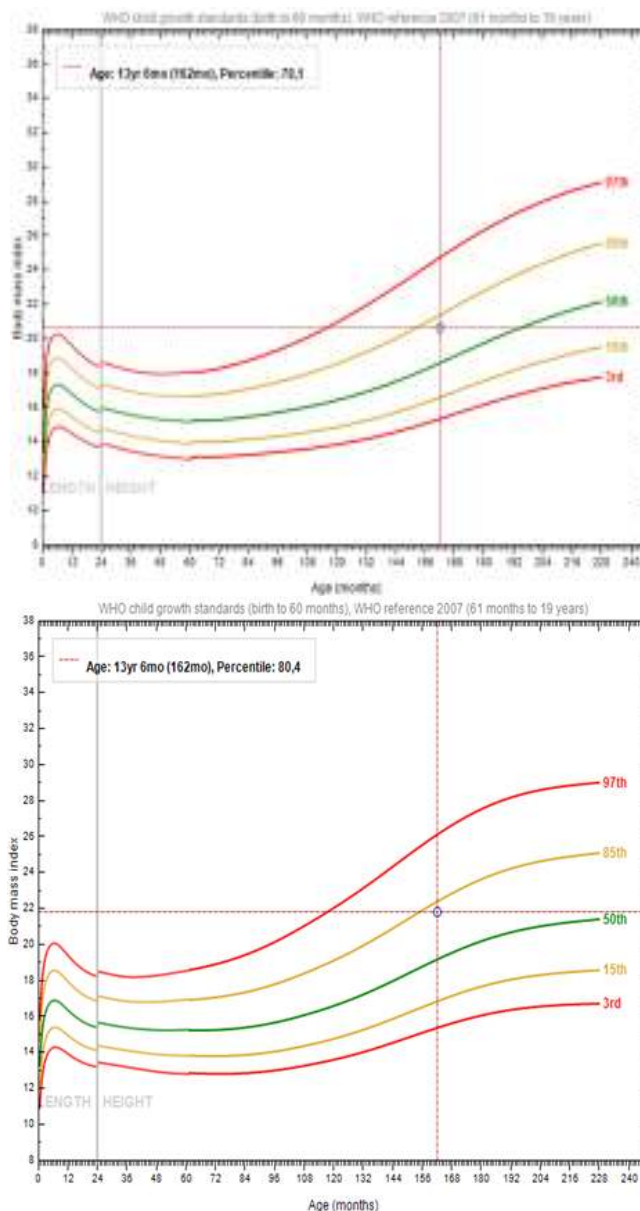
Discussion

Determining the nutritional status (by positioning the student BMI in relation to the standardized values recommended by WHO) is important for monitoring the growth and development of students. The results obtained in this study indicate that malnutrition and obesity in children are increasingly a problem for students in Montenegro. If we take into account malnourished and obese children, who are 8th grade students, it is concluded that 34.28% of boys and 37.11% of girls have problems with excess weight. The obtained results are in the range of child malnutrition results in Europe, where malnutrition (including obesity) ranges from 9 to 43% in boys and from 5 to 43% in girls, depending on the region; while obesity in European countries ranges from 2 to 43% up to 21% in boys and 1 to 19% in girls, with the higher rates in Mediterranean countries (Wijnhoven et al., 2014). Compared to the results of a previous study (Jakšić et al., 2017), where 37.5% of boys and 24.7% of girls were determined to be overweight and obese among the population of 7–12-year-old students (the year of measurement is 2012–2013), it can be concluded that the percentage of obese and malnourished boys in Montenegro is lower by 3.22%, while the percentage of girls who are overweight is higher by 12.41%. There are various reasons for these results in the state of nutrition.

One of the most important reasons is the fact that girls show a lower level of motivation and desire to engage in physical activity, primarily in physical education classes, which has been confirmed by previous studies (Kosinac & Banović, 2008; Jorgić & Veselinović, 2008; Gontarev & Kalač, 2017). Low levels of physical activity are known to be one of the main causes of obesity in children (Page et al., 2005). Of course, one of the problems is that educational curricula are not harmonized with the real needs of students because physical education classes have not significantly changed for decades even though, currently, the physical activity of students is reduced to the minimum level. According to the recommendations, children should have physical education classes at school every day to be physically active at least half of the time they spend in school, which should ensure a significant percentage of daily/weekly physical activity. However, a small number of students have daily physical education classes, and their engagement in these classes is less than 50% (Datar & Sturm, 2004). In addition, one of the reasons for the large percentage of overweight students of both sexes is that Montenegro is a country with mostly low and middle personal incomes, which limits parents in the ability to choose healthier and better food for the family.

Two-thirds of the world's obese people live in low- and middle-income countries, and it is assumed that the number of obese children in these countries will increase over time (Ng et al., 2014). Economically more developed countries are recording a declining trend in obesity among children. Between 1985 and 2014, the number of obese children in China declined from the initial value of 0.1% to 7.3% (Song et al., 2016; Wang, Dong, Wang, Zou, & Ma, 2017). Of note, students from the sample were born in the 21st century, when breastfeeding, as the basic form of infant nutrition, is unfortunately replaced by a large percentage of alternative foods even in the first days after birth.

The importance of breastfeeding, especially in the first 6 months, is very important for preventing obesity in later years, as indicated by the results of various studies (Mosca & Gianni, 2017; Eidelman & Schanler, 2012; Horta, Loret de Mola, Victora, 2015). The mean values of the overall sample BMI expressed in percentile values for boys (78.1 percentile) (Graph 1) and girls (80.4 percentile) (Graph 2) indicate that the entire sample moves on average towards the state of malnutrition. The distance from the 50th percentile as a mean of the nutritional status of the respondents is 28.1 percentile for boys and 30.4 percentile for girls.



Graph 1. Arithmetic mean percentile for boys

Graph 2. Arithmetic mean percentile for girls

Although malnutrition and obesity are global health problems (Ng et al., 2014) and subject of research by many scholars from almost all over the world (Bingham et al., 2013; Tyson & Frank 2018; Wei et al., 2020; Pojskić & Eslami, 2018; Zhang et al., 2018), it is clear that at the global level we do not have adequate answers to prevent overeating and obesity because absolute and relative figures depicting these states of malnutrition and obesity are rapidly increasing and indicate that we are far from solving the problem. If we evaluate this issue from the point of view of health status of children, it can be concluded that in the future we will have children and adults with higher mortality rates at younger age, cardiovascular diseases, diabetes, and deformities. In addition, it should be taken into account that obese children can be negatively labeled by peers, family, and other adults, and often such children have a poorer quality of life compared to children of normal weight (Beck, 2016). These issues will result in the absence of a healthy workforce, capable soldiers, firefighters, craftsmen, and athletes, which may contribute to a different culture of human life.

Conclusion

Based on the obtained results, it is concluded that almost every other student in the 8th grade in Montenegro does not have a normal level of nutrition; this refers not only to malnutrition and obesity, but also to malnutrition to some extent. Using the t-test for independent samples, a statistically significant difference was determined between boys and girls in BW and BMI, and the values are higher for girls. In addition, by

comparing the obtained values of BMI with standardized percentile values recommended by WHO (2007), a similar percentage of malnourished and obese boys and girls was determined, while the percentage of overweight girls is slightly higher than that of boys. To create a clearer picture of the nutritional status of primary school students in Montenegro, it is necessary to perform research on a larger sample and in all age groups of students so that the results could better help to prevent malnutrition and obesity in the youngest population. There are many risks associated with overeating and obesity in elementary school students. In addition to reduced motor potential of students, their ability to work, and quality of performance of daily life activities, the problem is reflected in health status as an increase in cardiovascular diseases, diabetes, and certain mental illnesses or mental instability, which is caused by lack of self-confidence owing to dissatisfaction with their appearance on one hand and exposure to mocking comments of the community on the other hand. To successfully prevent the increasing incidence of obesity in students, it is necessary that all social factors act in a coordinated manner. Until this occurs, the number of studies on childhood obesity in the world will increase, while the number of obese children will not decrease.

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Conflicts of interest

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