ANALYSIS OF NUTRITIONAL STATUS AND BODY COMPOSITION OF ELEMENTARY SCHOOL STUDENTS

Elvira Nikšić[1], Edin Beganović[2] and Amel Mekić[3]

[1]*Faculty of Teacher Education, University of Sarajevo, Sarajevo, B&H*
[2,3]*Faculty of Sports and Physical Education, University of Sarajevo, Sarajevo, B&H*

Abstract

Nutritional status is an indicator of the physical fitness and health status of an individual and the entire population. Monitoring the nutritional status is a very useful activity because it indicates the adequacy of the process of growth and development of children, helps to understand the current, and can also serve as a prognostic factor for their future health. The research was conducted on a sample of 136 students of primary school age, with an average age of 11.56. The aim of this research is to examine and determine the nutritional status and body composition of primary school students. The analysis of the degree of nutrition, as well as the composition of the body, was assessed by 34 variables using the bioelectric impedance InBody 720. The analysis was done with the help of descriptive statistics. Based on the obtained results, it was determined that out of the total number of respondents 136 (100.0%), included in this research, 1 (0.7%) respondent belongs to the category of malnourished. 42 (30.9%) students are overweight, and 25 (18.4%) students are obese, while 68 (50.0%) respondents are of normal body weight. A survey conducted on a total sample of respondents showed that almost half of the respondents are overweight. The obtained data indicate a big problem of today, which is conditioned by bad habits and lifestyle. Nutrition has a significant role and impact on the health of every individual throughout life, especially in children of elementary school age, because by meeting basic energy needs and adequate intake of nutrients, a well-balanced and proper diet ensures proper growth and development. Parents are the ones who play the most important role in creating a positive eating habit in children. Even in early childhood, children accept the good and bad habits of their parents. So if parents adhere to a proper diet and manage to build those habits in their children, then they can be sure that their child will continue to adhere to the rules of proper nutrition throughout their lives.

Key words: *nutritional status, body mass index, body composition, elementary school, health.*

Introduction

Due to its simplicity and precision, the body mass index (BMI) is widely used in assessing 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 common criterion for determining childhood obesity has been used by many studies in the 85th and 95th percentiles. This criterion thus increases the number of overweight and obese children, and national studies are needed to determine certain criteria and standards. Children whose BMI is between the 85th and 95th percentile are overweight, and those with a BMI greater than the 95th percentile are obese. As the BMI increases, the thickness grades increase, so the thickness of the first BMI grade is from 30.0 to 34.9 kg / m2, the thickness of the second grade is 35.0 to 39.9 kg / m2, and the thickness of the third BMI is greater than 40 kg / m2. The International Classification of Diseases notes that any thickness (BMI greater than 30 kg / m2) is a disease. The body mass index is calculated by dividing the body weight in kilograms by the height expressed in meters squared. A person with a normal body mass index is from 18.5 to 24.9 kg / m2, persons with a BMI of 25.0 to 39.9 kg / m2 are considered malnourished (Štampar, 2016). The most significant disorder is obesity which is more and more prevalent in adolescent children. Ten years ago, statistical data showed that 10.5% of children in Croatia have increased body weight, and 3.8% of them are obese. The latest data from the CNIPH show that 26.4% of school-age children are overweight, while 11.2% are obese. Croatia is in a worrying FIFTH place in Europe in terms of the number of overweight children (Kolarić and Nožinić, 2016). Baranowski and Taveras (2018) point out that the current approach to the issue of childhood obesity has not yielded the expected results and that it is necessary to strengthen preventive activities at all levels, starting with parents. Nutrition and school are related for several reasons and thus affect the analysis of nutritional status and body composition of primary school age students. Own choice and consumption of food, nutrition is no longer completely under the control of parents, they eat at least one meal a day or even several snacks without supervision. Modern, fast lifestyle also affects diet, lack of time, life dynamics and increasing employment of parents affect that children and young people consume food more often outside the home, more often they eat meals that are rich in energy in terms of nutritional composition, but do not contain a sufficient amount of nutrients and protective substances - vitamins

and minerals (Taljić, 2019). In the research conducted on the ITOF criterion, the majority of children, 165 or 65.74% of them were normally fed, as many as 21.51% were malnourished, while children with increased body weight were 7.97% and 4.78% obese (Paić, 2019).

Based on all of the above, the aim of this research is to examine and determine the nutritional status and body composition of primary school students.

Methods

Participants
The study included a sample of 136 students divided into two subsamples: 67 boys with average Body Height (BH) (Mean ± Std.Dev.) 156.44 ± 10.37 cm, Body Weight (BW) 50.25 ± 11.57 kg and Body Mass Index (BMI) 20.32 ± 3.22 kg / m2, chronological age 11.63 ± 0.95 years and 69 girls average BH 156.31 ± 8.09 cm, BW 49.07 ± 12.09 kg and BMI 19.87 ± 3.66 kg / m2, chronological age 11.55 ± 0.90 years. The testing was conducted in the hall for physical education of the Gymnasium Obala, Sarajevo, Bosnia and Herzegovina. The research was approved by the Ethics Commission of the Faculty of Education, University of Sarajevo in accordance with the Declaration of Helsinki (World Medical Association, 2013). All parents were informed about the implementation of the research, which explained the purpose and goal of the research. Therefore, the research was supported by all parents, who gave their written consent.

Research Design
The sample of measuring instruments used in the research represents a set of 34 variables. Four variables were used to assess anthropometric characteristics: BH, BW, BMI and Waist-Hip Ratio (WHR). 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). Thirty variables were used to assess body composition: ten variables to assess body composition: Total Body Water (TBW), Proteins, Minerals, Body Fat Mass (BFM), Soft Lean Mass (SLM), Fat / non-fat tissue ratio (Ratio BFM / SLM), Fat Free Mass (FFM), Skeletal Muscle Mass (SMM), Minerals in the Bones (MB), Percent Body Fat (PBF); Ten variables for segmental display of body muscle mass: FFM of Right Arm,% FFM of Right Arm, FFM of Left Arm,% FFM of Left Arm, FFM of Trunk,% FFM of Trunk, FFM of Right Leg,% FFM of Right Leg , FFM of Left Leg,% FFM of Left Leg; Ten variables for segmental adipose tissue: BFM of Right Arm,% BFM of Right Arm, BFM of Left Arm,% BFM of Left Arm, BFM of Trunk,% BFM of Trunk, BFM of Right Leg,% BFM of Right Leg, BFM of Left Leg,% BFM of Left Leg. Body composition was measured with an InBody720 Scale (Aandstad, Holtberget, Hageberg, Holme, & Anderssen, 2014).

Statistical Analaysis
All data collected by the survey were processed by descriptive statistics procedures.

From the space of descriptive statistics, measures of central tendency and measures of variance were calculated for each variable. The statistical program for personal computers SPSS for Windows-version 20.0 was used for data processing.
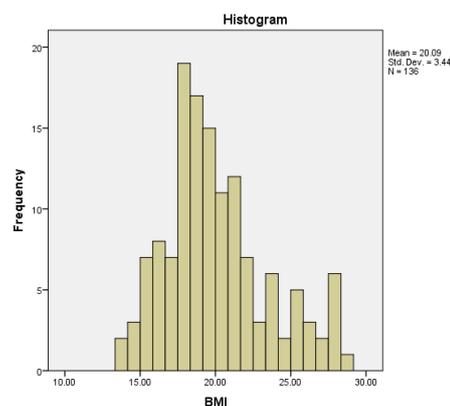
Results

In the following part of the paper, presentations of average values and measures of deviation related to variables of height, weight, BMI, and variables of body composition of the respondents are given.
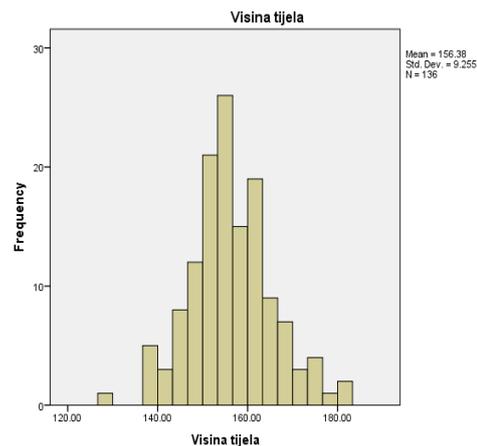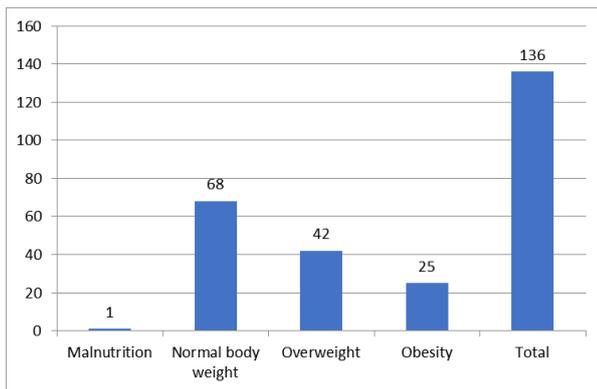

Graph 1. Height
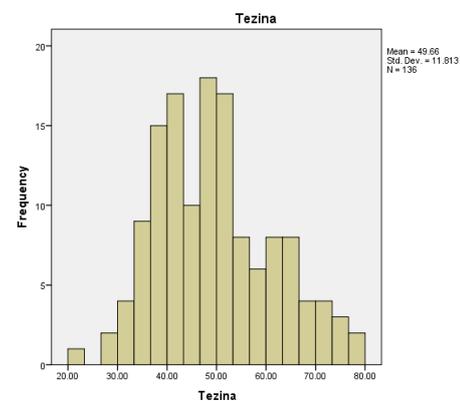
Graph 2. Weight

Graph 3. Body mass index (BMI)

Graphs 1, 2, and 3 show the mean value and standard deviation for height, weight, and BMI.

Graph 4. Display of body mass index by categories for the total sample of respondents

By looking at Chart 4, we can see that out of the total number of respondents 136 (100.0%), included in this research, 1 (0.7%) respondent belongs to the category of malnourished. 42 (30.9%) students have excessive BM, and 25 (18.4%) students are obese, while 68 (50.0%) respondents have normal BM. A survey conducted on a total sample of respondents showed that almost half of the respondents are overweight.

Table 1. Central and dispersion parameters related to the general body composition of the subjects

Variables	Mean±Std.Dev.
Total ody liquid	27.221±5.704
Proteins	7.285±1.549
Minerals	2.624±0.559
Fat tissue	12.531±6.733
Non-fat tissue	34.953±7.338
Muscle mass	37.052±7.828
Skeletal muscle mass	19.946±4.667
Bone minerals	2.179±0.469
Body fat percentage	24.223±8.991

Table 2. Central and dispersion parameters related to the presence of muscle mass in the subjects

Variables	Mean±Std.Dev.
Right arm muscle mass	1.6760±0.514
% of right arm muscle mass	92.4331±16.043
Left arm muscle mass	1.6545±0.505
% of left arm muscle mass	90.1846±17.062
Torso muscle mass	16.0434±3.336
% of torso muscle mass	98.7963±7.816
Right leg muscle mass	5.6146±1.499
% of right leg muscle mass	98.1794±9.696
Left leg muscle mass	5.5695±1.470
% of left leg muscle mass	97.8456±9.704

Table 3. Central and dispersion parameters related to the presence of adipose tissue in the body

Variables	Mean±Std.Dev.
Adipose tissue of the right arm	0.8816±0.536
% of adipose tissue of the right arm	31.5779±11.221
Adipose tissue of the left arm	0.8824±0.511
% of adipose tissue of the left arm	32.1044±10.936
Adipose tissue of the torso	5.7338±3.753
% of adipose tissue of the torso	23.1713±10.976
Adipose tissue of the right leg	2.0544±0.925
% of adipose tissue of the right leg	25.3978±7.939
Adipose tissue of the left leg	2.0515±0.922
% of adipose tissue of the left leg	25.3993±7.941

Table 4. Central and dispersion parameters related to the waist-to-hip ratio

Variable	Mean±Std.Dev.	
Waist-to-hip ratio	0.823	0.049

Discussion

Nsibambi (2013) on a sample of 1929 children aged 6 to 9 from Uganda states that 4% of children were malnourished, 85% normally fed, 7% overweight and 4% obese.

The results on a sample of respondents aged 11 to 14 indicate that only 62% of students were properly fed, while 33% fell into the category of overweight and 5% were obese. This fact indicates a significant and worrying relative increase in body weight and obesity in this age group (Podnar et al. 2013).

Childhood obesity increases the risk of adulthood obesity and is associated with a range of comorbidities, from type 2 diabetes, hypertension, nonalcoholic fatty liver, respiratory distress, and many others. 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 nutrition of children in the Sarajevo Canton shows that 78.10% have normal nutrition, 12.30% are overfed, 7.10% are obese and 2.50% are malnourished (Taljić and Nikšić, 2016).

Insight into the Croatian Health Statistics Yearbook issued every year by the Croatian Institute of Public Health, based on 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, 3.73% of students were malnourished, 12.85% heavy and 17.74% obese in primary schools. If we exclude children of normal body weight, in other categories there are 34.32% of primary school children (Puharić et al., 2016). Among primary school children in Sarajevo Canton, in which a total of 33,200 students participated, an extremely large number of overweight children were recorded. Of the total number of students included in this research, as

many as 39.6% (13,159) were obese. In addition, it is worth noting that 9.7% (3,206) of students in Sarajevo Canton are malnourished. According to the results of this research, every other child has an eating disorder (49.3%), and this could be said to be extremely worrying (Abazović et al., 2016). A large study conducted on a sample of respondents aged 11-12 shows that 36.6% of children are overweight and obese (Šimestin Pavić, 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 as much as tenfold (WHO, 2018). The etiology of childhood obesity is very complex, but eating and living habits play a very important role (Kumar and Kelly, 2017). In the research conducted on a sample of 234 fifth grade students of primary schools in Međimurje County, there were more girls 125 (53.4%) than boys 109 (46.6%), average age 11.5 years. There were 14 (2.9%) malnourished and lean people in this study, and 4.8% in Croatia, 160 (68.4%) were normally fed, 82% in Croatia, 10 were overweight (4.3%), and there were 26 (11.1%) obese, while in Croatia they were 13.7%. The average body weight was 43.5 kg, while the median height was 152 cm (Gasparić, 2017).

A study conducted in Bjelovar-Bilogora County on 466 fifth-grade primary school students showed that 15% were malnourished and lean, 56% were normally fed, and 29.0% were overweight and obese (Menari Archanjo, 2017). Observing the general results based on the conducted research on determining the obesity of primary school children in the City of Mostar, in which a total of 1940 students participated, 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 a normal body weight. In addition, it is worth noting that 7.4% (144) of respondents were malnourished. According to the obtained results, almost every other child has an eating disorder (43.9%), which is extremely worrying and alarming (Čolakhodžić et al., 2017).

Although BMI does not show body composition, and neither the proportion of fat that determines obesity (Mišigoj, Duraković, et al., 2014), the obtained nutritional status results of most respondents show obesity, but also in the analysis of body composition a very high proportion of adipose tissue. That is, a comparison of BMI values with adipose tissue percentage shows a positive correlation of data in both genders. The strong association of BMI with adipose tissue shows that subjects with a higher body mass index also have a higher proportion of adipose tissue (Platužić, 2018). Similar research (Akindele, et al., 2016; Hasanović, 2017) also confirms the knowledge about the interrelationship between BMI and adipose tissue content.

The research was conducted on a sample of 136 students (67 boys and 69 girls), with an average age of 11.56 years. The aim of the study 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, T-test for small independent samples, it was determined that there are no statistically significant differences between boys and girls, both in the degree of nutrition and body composition, estimated by 10 variables using bioelectric impedance InBody 720. Also, it was found that 19.70% of boys are obese, as well as 17.40% of girls. Cumulatively with the percentage of malnourished respondents, a total of 61.50% of boys were not normally fed, as were 37.70% of girls. The obtained results indicate the need for a more extensive review of the analyzed segments and a significantly larger sample of respondents, in order to act preventively in the fight against obesity, as the leading epidemiological health problem of today. Conclusions: It is obvious that physical activity based on physical education classes is not sufficient or is not sufficiently represented to meet the challenges of the modern way of life of children. (Nikšić et al. 2021)

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 (Nikšić, Beganović, Mekić, 2020).

Conclusion

Based on the obtained results, it can be concluded that there is a large number of elementary school students who are overweight and obese. More specifically, out of the total number of respondents 136 (100.0%), included in this research, almost half of the respondents, 67 (49.3%) are overweight.

With proper nutrition and regular physical activity, we maintain good health throughout life. Proper nutrition in children is especially important. Nutrition has a significant role and impact on 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 necessary for tissue building (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 gives good results and successful work of "small gray brain cells" that need to store a lot of information throughout the year. In order to have a balanced and varied diet, it is first of all necessary to adopt proper eating habits from your 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, development) and enable the smooth performance of all daily activities (learning, playing, resting, sleeping). Eating problems are common and serious in all age groups. Unfortunately, more and more young people are suffering from various diseases caused or worsened by inadequate nutrition. School doctors and psychologists tend to immediately organize exercises to correct these anomalies, and when it comes to increased body weight or malnutrition, to leave it to parents to systematically examine children's posture irregularities, visual or speech disorders, and to correct these anomalies. worry or don't pay much attention to it. The level of nutrition is one of the indicators of the state of the organism and in order to maintain it in normal values, it is necessary to consume a variety of foods, divide daily meals into five smaller ones and adhere to the guidelines of proper nutrition. It is necessary to take in about two liters of fluid in the body, and regularly engage in physical activity. Daily energy intake in the body should be equivalent to its consumption through daily activities.

Acknowledgements

References

Abazović, E., Hasanbegović, S., Kovačević, E., Okanović, I., Kazazović, E., Ademaj, Z., Lakota, R., Mekić, A. (2016). Pretilost djece osnovnih škola Kantona Sarajevo: 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, M.O., Phillips, J.S., & Igumbor, E.U. (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 7:515.

Baranowski, T., & Taveras, E.M (2018). Childhood Obesity Prevention: Changing the Focus. Child Obesity 14(1):1-3.

Čolakhodžić, E., Vuk, N., Habul, Ć., Vujica, S., & Tanović, S. (2017). Pretilost i posturalni status djece osnovnoškolskog uzrasta u gradu Mostaru.[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.

Gasparić, T. (2017). Prehrambene navike i socioekonomski čimbenici koji utječu na stupanj uhranjenosti učenika petih razreda Međimurskežupanije. [Eating habits and socioeconomic factors that affect the level of nutrition of fifth grade students in Međimurje County.] Graduation thesis, Josip Juraj Strossmayer University of Osijek, Faculty of Medicine Osijek, Čakovec, pg. 33 – 39.

Hasanović, J. (2017). Procjena učestalosti disfagije u osoba starijedobi u domovima za starije osobe u Zagrebu i povezanost s nutritivnim statusom. [Assessment of the frequency of dysphagia in the elderly in nursing homes in Zagreb and the relationship with nutritional status.]. Graduate thesis. Faculty of Food Technology and Biotechnology, Zagreb.

Kolarić, T., Nožinić, D. (2016). Pretilost - loše navike ili stil života današnjice. [Obesity - bad habits or lifestyle of today.] Split, Croatian Spring Pediatric School.

Kumar, S., & Kelly, A.S. (2017). Review of child hood obesity: from epidemiology, etiology and comorbidities to clinical assessment and treatment. Mayo Clinic Proceedings 92(2):251-265.

Menari Archanjo, R. (2017). Acao Educacional Claretiana. Linguagem academica. [Claretian Educational Action. Academic Language.] Clarentina.

Mišigoj-Duraković, M., Sorić, & M., Duraković, Z. (2014). Antropometrija u procjeni kardio-metaboličkog rizika. [Anthropometry in cardio-metabolic risk assessment.] Archives of Occupational Hygiene and Toxicology 65:19-27.

Nikšić, E., Beganović, E., & Mekić, A. (2020). Differences in the nutritional status and body composition of 6th and 7th grade students in Bosnia and Herzegovina. Journal of Physical Education and Sport, 20(5):2787-2795. DOI:10.7752/jpes.2020.s5379

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

Nsibambi, C.A.N. (2013). Body Composition Analysis of Pupils in Urban Schools in Central Uganda. IJBSS, 4 (7), 135-141.

Paić, A. (2019). Utjecaj roditelja na stanje uhranjenosti te prehrambene i životne navike djece starosti 7 godina. [The influence of parents on the state of nutrition and eating and living habits of children aged 7 years.] Specialist work, Josip Juraj Strossmayer University of Osijek, Faculty of Food Technology, Osijek.

Platužić, I. (2018). Procjena statusa uhranjenosti starijih osoba. [Assessment of the nutritional status of the elderly.] Graduate work, Josip Juraj Strossmayer University of Osijek, Faculty of Food Technology, Osijek.

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.] 22nd Summer School of Kinesiology of the Republic of Croatia, Zagreb, Croatian Kinesiology Association, pg. 522-527.

Puharić, F., Rogović, D., & Puharić, Z. (2016). Stanje uhranjenosti učenika osnovnih i srednjih škola u 2016 godini. [Nutritional status of primary and secondary school students in 2016.] Croatian Journal of Public Health, Vol 13, Number 51.

Sahoo, K., Sahoo, B., Choudhury, A.K., Sofi, N.Y., Kumar, R., & Bhadoria, A.S. (2015). Childhood obesity: causes and consequences. Family Medicine Primary Care 4(2):187-192.

Šimestin Pavić, I., Mayer, D., Musić, Milanović, S., Pejnović Franelić, I., & Jovičić, D. (2016). Croatian Institute for Public Health. Research on student health behavior. Basic indicators of health and well-being of male and female students in Croatia, 2013./2014. Zagreb; 1/58.

Taljić I., & Nikšić E. (2016). Impact of food habits to BMI category of adolescent boys, University of Novi Sad, Faculty of Technology Novi Sad, Novi Sad 2016. pp:26.

Taljić, I. (2019). Ishrana školske djece i adolescenata .Nutrition of school children and adolescents. University of Sarajevo, Center for Interdisciplinary Studies, Sarajevo.

WOF/WHO, World Obesity Federation and World Health Organization: Taking Action on Childhood Obesity Report. World Health Organization, 2018. http://apps.who.int/iris/bitstream/handle/10665/274792/WHO-NMH-PND-ECHO18.1-eng.pdf?ua=1

Correspondence to:
Elvira Nikšić
Faculty of Teacher Education, University of Sarajevo, Sarajevo, B&H
e-mai: elvira.beganovic1982@gmail.com