Original article

The State of Oral Health in Children With Increased Body Weight In Montenegro

Mirjana Đuričković [1], Milan Martinović [1], Milica Martinović [2], Marina Jakšić [3], Mirjana Nedović-Vuković [4]

[1]University of Montenegro, Faculty of Medicine, Department of Dentistry, Podgorica, Montenegro; [2]University of Montenegro, Faculty of Medicine, Department of Pathophysiology and Laboratory Medicine, Podgorica, Montenegro; [3]Institute for Children's Diseases, Department of Laboratory Diagnostics Podgorica, Montenegro; [4]Institute of Public Health, Podgorica, Montenegro

Summary. *Background/Aim:* The aim of this study was to determine the state of oral health in children with increased body weight in Montenegro compared to children with normal body weight. *Materials and methods:* The study included 201 patients aged 9-14 years. Assessment of nutritional status of subjects was performed by the use of U.S. Centers for Disease Control and Prevention (CDC) criteria. The respondents were divided into group of increased body weight children (IBW) and group of normal body weight children (NBW). Presence or absence of dental caries was assessed the decayed, missing, filled teeth (DMFT) index. The Plaque Index (PI) according to Silness-Löe and the Calculus Index (CI) by Green were used to determine oral hygiene. Modified Community Periodontal Index (CPI) was used for the assessment of periodontal tissue. Information on oral hygiene and dietary habits were obtained from the using a questionnaire. *Results:* There were no significant differences in the average values of the DMFT index, CI values and average CPI Index value between the observed groups. PI values in the IBW group was 1.08 ± 0.54 while in the NBW group it was 0.89 ± 0.53; the difference was statistically significant ($p = 0.034$). Children from the IBW group had significantly worse oral hygiene habits ($p = 0.029$). *Conclusion:* Children with increased body weight have no more affected teeth and they have not a worse condition of periodontal tissue in comparison to children with normal body weight. However, they have a worse condition of oral hygiene and oral hygiene habits.

Key words: BMI, children, dental caries, DMFT index, oral health, oral hygiene

Introduction

Obesity is one of the leading public health problems nowadays with an increasing prevalence in children and adolescents. It is an important risk factor for the occurrence of cardiovascular disease, arterial hypertension, type 2 diabetes, dyslipidaemia, cancer, etc. (1,2). Therefore obesity is regarded as a disease, and its treatment as a prevention of various diseases (1,2).

The onset of obesity in childhood is largely related to obesity in adulthood. In 2006, the European Commission reported that 22 million children in the European Union with overweight or obesity, with an incidence increase of 400.000 new cases per year (2). In Montenegro the overall prevalence of childhood overweight and obesity according to U.S. Centers for Disease Control and Prevention (CDC) criteria is 24.5% (3). The lack of physical activity, lose changes in eating habits and social change are seen as key factors for the global spread of obesity (4), and at the same time they represent risk factors for the occurrence of oral diseases (5,6)

Diseases of the mouth and teeth due to the large prevalence and complications they give are considered a serious public health problem. Dental caries is the most common chronic illness of childhood. Surveys on the effect of excessive body weight on the oral health of children are controversial. Some authors find greater prevalence of caries and periodontal disease (5,6), while others do not find differences between children with increase body weight and children with normal body weight (7). Literature generally gives information on the effect of overweight on general health, while data on the effect of obesity on the teeth, gingiva and condition of periodontal tissue are very scarce. Considering that oral health is an important part of overall health, the aim of this study was to determine if the condition of oral health of children with increased body weight is different from that of children with normal body weight in Montenegro.

Materials and Methods

The study was conducted in accordance with the Helsinki Declaration. The consent of the Ethical Committee of the Medical Faculty University of Montenegro in Podgorica was obtained for the research. Decision No. 3399, dated 24 December 2013).

Sample

The data used in this study were collected as a part of the national survey of school children obesity in Montenegro (2013-2016) entitled the "Research on Obesity and Poverty of Children in Montenegro - Clinical, Pathophysiological, Biochemical and Preventive Aspects"(3). The sample in this cross-sectional study comprised 201 children aged 9-14 years, 128 boys and 73 girls, randomly chosen from ten elementary schools from Podgorica, within a representative national sample of children (3). Informed approval was obtained from all children and their parents. The survey response rate was 100% (202 survey invitation letters delivered). Based on Centers for Disease Control and Prevention (CDC) criteria, the respondents of this study were evenly divided into two groups, children with increased body weight (IBW) and children with normal body weight (NBW). The IBW group (BMI>85 percentile) consisted of 109 patients. The NBW group (BMI 5-85 percentile), consisted of 92 patients (8). Exclusion criteria were underweight children, those with endocrine and metabolic disorders (secondary obesity), chronic diseases, usage of medicines leading to metabolic disturbances (e.g., corticosteroids), and those who were not willing to participate in the examination.

Anthropometrics

Children were weighed barefoot and in light clothes on a digital scale accurate to 0.1 kg (SECA, model SE 808). A stadiometer was used for body height measurements accurate to 0.5 cm (GIMA, code 27328). The calculation of body mass index (BMI) was performed using formula: body weight in kilograms divided by the square of height in meters. According to the Centers for Disease Control and Prevention (CDC) growth references for children and adolescents, BMI between the 5th and 85th percentiles is categorized as “normal weight” children and adolescents, those with a BMI between the 85th and 95th percentiles are classed as “at risk of overweight”, and those with a BMI greater than the 95th percentile as “overweight” (8). Children and adolescents with BMI <5th percentiles were excluded from this study.

State of oral health

All dental assessments were performed by two dentists on the principles of Good Clinical Practice. In testing the reliability of the researchers, kappa statistics was used. Kappa values evaluated after a review for the intra consistency of the researchers amounted to 0.95.

All participants underwent dental assessment with the use of standard dental diagnostic instruments. Dental caries was determined by DMFT index (decayed, missed, filled teeth) for permanent dentition, according to World Health Organization (WHO) standards (9). Clearly visible lesions with cavity formed on the surface of the tooth are registered as teeth caries, while changes in transparency or initial demineralization of the teeth with an intact surface, without cavitation registered as healthy teeth. For assessment

of the state of oral hygiene, the Plaque Index (PI) according to Silness-Löe (10) determines the absence, or the presence, quantity and distribution of dental plaque and other soft deposits on teeth as well as the Calculus Index (CI) by Green which determines the absence, or the presence of dental calculus on the teeth (10). Assessment of the state of health of periodontal tissue was recorded by the modified Community Periodontal Index (CPI), according to WHO recommendations for subjects under 15 years of age. In children of this age, the state of periodontal tissue is determined based on the clinical state of the gingiva (9).

Questionnaire

The parental questionnaire consisted of two parts. Part 1 included questions on socioeconomic data (municipality, school, grade, gender, date of birth, parents' education and employment, parents' marital status, number of children at home, family income). The second part was focused on children, including questions on their oral hygiene habits (tooth brushing at bedtime; tooth brushing in the morning; brushing with fluoridated toothpaste) and questions that assessed dietary habits (the number of daily meals, the frequency of sweets consumed and sugar-sweetened fizzy drinks while staying to the school). After the analysis of the questionnaire, the socioeconomic status assessment was implemented. Socio-economic status is classified into low, moderate, or high, according to the household income, with nationally defined cutoffs according to Eurostat (11). After examining, every child was trained to properly brush his/her teeth.

Statistical analysis

The statistical analyses were performed using IBM SPSS Statistics for Windows, Version 22.0. The Shapiro-Wilk test was used for testing normality of variable distribution. The differences of individual parameters between the studied groups were tested with Mann-Whitney U test, Student's t test and Chi square test. The results are presented as means and standard deviations (SD) and medians and interquartile ranges for numerical variables and as percentage for categorical. We compared the means and medians of examined variables for the two groups of children in order to detect any significant differences in the state of oral health. The conclusion was carried out at the significance level $p < 0.05$.

Results

The average age of children with increased body weight was 11.03 ± 1.50, while the average age of children from the control group was 10.8 ± 1.43 ($p = 0.283$).

In the total sample, 10% of children had all permanent teeth healthy. The percentage of children with all healthy permanent teeth in the IBW group was 8.5%, while in the NBW group it was 12%. Testing the results did not show statistically significant differences in the values of this index ($\chi^2 = 0.762$, $p = 0.383$).

The results indicate that there is no significant difference in the tooth condition between the observed groups. There was no significant difference between the study groups in the median and the average values of caries, extracted and filled teeth (Mann-Whitney U test, t test, $p>0.05$). There was no difference in the median and the average values of DMFT (Mann-Whitney U test, t test, $p>0.05$). The filled teeth in the NBW group dominated. The number of caries and extracted teeth was higher in the IBW group (Table 1, Figure 1).

Children with increased body weight had significantly higher median and average values of the Plaque index compared to children in the control group (Mann-Whitney U test, $p=0.034$; t-test, $p=0.014$). Respondents from IBW group had higher median and average values of CI compared to those in the NBW group (Table 1), which was not statistically significant (Mann-Whitney U test, t-test, $p>0.05$).

There was no significant difference (Mann-Whitney U test, t- test, $p>0.05$) in the median and the average value of the CPI index between the IBW group (0.98 ± 0.76) and the NBW group (0.82 ± 0.80). A higher percentage of children with healthy gingiva was registered in the NBW group. Contrary to this, a gingival bleeding after probing was more found in children with increased body weight compared to controls, but it was not statistically significant (χ^2 -test, $p>0.05$).

Table 1. Oral health status and dental indexes in the study groups

Parameter	IBW (n=109)		NBW (n=92)		p	
	Median (interquartile range)	Mean±SD	Median (interquartile range)	Mean±SD	Non parametric testing	Parametric testing
D	1 [0-3]	1.92±2.18	1 [0-3]	1.60±2.00	0.262	0.284
M	0 [0-0]	0.12±0.54	0 [0-0]	0.08±0.30	0.979	0.488
F	1 [0-3]	1.86±2.25	2 [0-4]	2.15±2.26	0.229	0.366
DMFT	4 [2-5]	3.90±2.53	4 [2-4]	3.83±3.03	0.383	0.853
PI	0.99[0.00-0.24]	1.08±0.54	0.00 [0.00-0.24]	0.89±0.53	0.034	0.014
CI	0.00 [0.00-0.24]	0.17±0.33	0.00 [0.00-0.00]	0.13±0.26	0.422	0.335
CPI	0.00 [0.00-0.24]	0.98±0.76	0.00 [0.00-0.24]	0.82±0.80	0.119	0.131
CPIcategorical 0	32 (29.4%)		39 (42.4%)		0.054	
1	77 (70.6%)		53 (57.6%)			

IBW – increased body weight children; NBW – normal body weight children;
DMFT – Decayed, Missing, Filled Teeth;
PI – Plaque Index; CI – Calculus Index;
CPI – Community periodontal index: 0 – healthy periodontium, 1 – gingival bleeding after probing

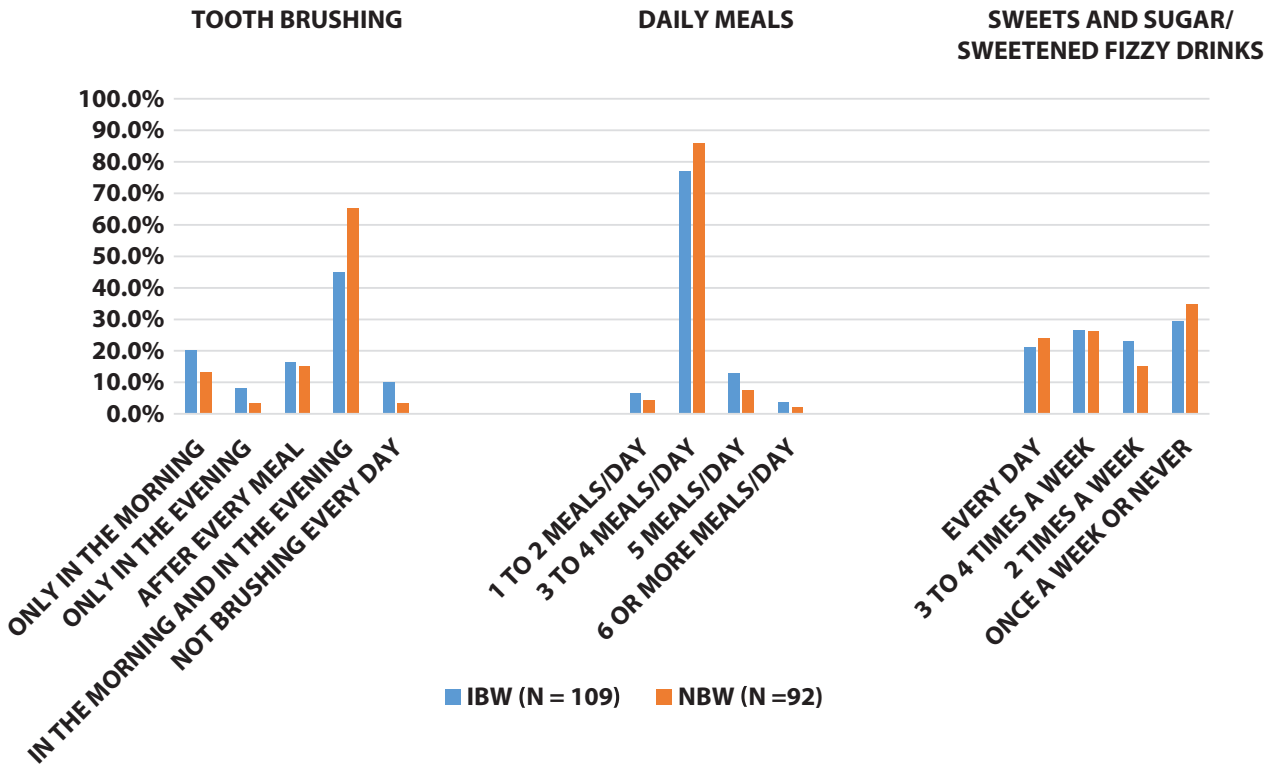

Figure 1. Number of D, M and F teeth in the studied group
IBW – increased body weight children; NBW – normal body weight children;
D-Decayed Teeth; M-Missing Teeth; F-Filled Teeth

Distribution of CPI index percentages are presented in Table 1.

Socioeconomic family statuses were similar for both groups (χ^2test, $p>0.05$).

Significantly more examinees from the NBW group brushed their teeth twice a day (in the morning and in the evening), while a large number of children from the IBW group brushes their teeth only once a day (only in the morning, only in the evening) or do not brush them every day (χ2-test = 10.762, $p=0.029$). When it comes to the number of daily meals, there is no significant difference between the examinees (χ2-test, $p>0.05$). There was no significant difference in the consumption of sweets in school between the two groups observed (χ2-test, $p>0.05$). All the examined children brushed their teeth with fluoridated toothpaste. Oral hygiene habits and dietary habits in the study groups are presented in Figure 2.

Figure 2. Oral hygiene habits and dietary habits in the study groups

Discussion

This study examined the association between increased body weight in school children and the condition of oral health. This is the first study dedicated to this topic in Montenegro. Oral health is a part of general health and is of great importance for the normal functioning and quality of life. Oral health affects the proper development of the orofacial system and the aesthetic appearance (3).

Dental caries and obesity are diseases associated with increased intake of fermentable carbohydrates. It would be logical to assume that it will correlate well. However, most authors did not establish the relationship between dental caries and overweight. Studies conducted in Holland (12), Mexico (13) and Turkey (14) found no correlation between these two diseases. Markovic et al. in children with overweight in Serbia, they found lower DMFT despite higher consumption of sweets (15). A negative correlation between dental caries and overweight was found in the Sohn study (16). In contrast, higher incidence of caries in children with increased body weight has been found in another studies (17). Willerhausen et al. (18) established a significant correlation between the frequency of caries and body weight.

In our study, the percentage of children in the IBW group with all healthy teeth in Montenegro was slightly lower than the control group. When we observe the average values of the median and the average values of DMFT index among comparable groups, the results of our study did not indicate an association between excessive weight and affected permanent teeth in children.

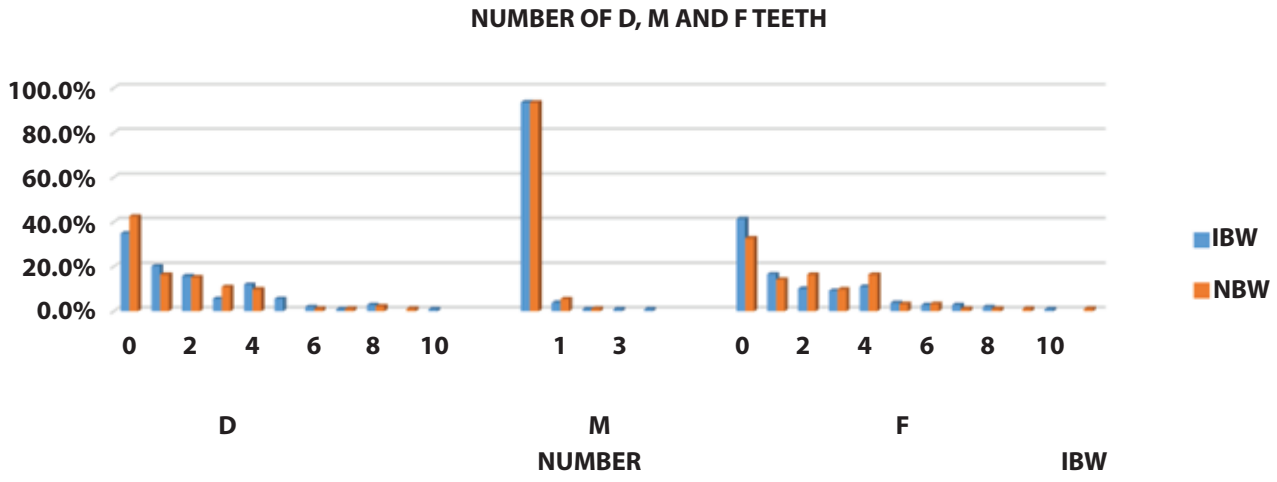

Figure 2. Oral hygiene habits and dietary habits in the study groups. IBW–increased body weight children; NBW– normal body weight children; Tooth brushing: $\chi^2=10.762$; $p=0.029$; Daily meals: $\chi^2=2.552$; $p=0.446$; Consumption of sweets and sugar/sweetened fizzy drinks $\chi^2=2.174$; $p=0.537$;

This could be explained by the fact that most children brush their teeth with fluoride toothpaste at least once a day, have a generally similar number of meals and similar habits for carbohydrate ingestion. In support of this, studies suggest that the development of caries is much more frequent in the consumption of sweets than the quantity (19, 20). Also, the development of dental caries is an important socioeconomic status, and the participants in our study were with a very similar socioeconomic statuses, which explains similar values of the DMFT index. However, after analysing individual components of DMFT, it was noted that dental caries in children with increased body weight were dominant. The filling teeth dominated in the NBW group.

Namely, in the IWC group a significantly worse condition of oral hygiene was established. The habit of brushing teeth twice a day was determined in only 45% of children with increased body weight, while 10% of these children did not brush their teeth every day. This could indicate that children with high body weight neglect both general and oral health. The results of our research are generally in agreement with the results of studies conducted in Turkey (14), Bosnia (21) and Iran (22).

The results of this research indicate a high percentage of children with diseased permanent teeth (90%). This data points to the absence of preventive measures and programs in Montenegro, so it is necessary to establish a strategy for controlling dental caries.

The results of this study indicate that children in the IBW group they have a worse condition of gingiva compared to children in the NBW group, but this difference was not statistically significant. Gingival bleeding after probing was the highest percentage of children with increased body weight, which was expected. These subjects mostly brushed their teeth once a day and had significantly worse oral hygiene than children with normal body weight.This finding indicates that children with increased body weight may be at risk for gingivitis and periodontal disease. Most studies concluded that the incidence of chronic gingivitis in patients with increased body weight was significantly higher and increased with age (15,21,23,24,25). The average value of the CPI index of our respondents indicates the necessity of training children with proper oral hygiene. Namely, oral hygiene habits play an important role in the preservation of gingiva and periodontal tissues. Although our study did not find a correlation between excessive body mass and gingivitis, it indicates poor oral hygiene of children with increased body weight, which in the long run can lead to periodontal disease and systemic chronic inflammation.

Our respondents spend most of their time in school. Only 31.8% of our respondents consume once a week or never sweets and sugar-sweetened fizzy drinks while at school. Although children with normal body weight consumed more frequent sweets, there were no significant differences in the use of sweets in the school during the comparative groups.This data points to the need to educate teaching staff, parents and children in terms of fostering healthy lifestyles. Irregular diet and poor oral hygiene are risk factors for obesity, caries, and periodontal disease. Therefore, programs for the promotion of oral health, proper nutrition and physical activity should be implemented in Montenegro.

Conclusion

Children with increased body weight have no worse oral health than children with normal body weight. However, they have a worse condition of oral hygiene and oral hygiene habits, which in the future could lead to risk of occurrence of periodontal diseases. Also, children from both groups have high average DMFT values, which indicates curative-oriented dentistry in Montenegro and the absence of preventive and prophylactic measures.

Acknowledgements : The study was financially supported by the Montenegrin Ministry of Science, Contract No. 01-1366/2012.

Conflict of interest disclosure: The authors declare that they have no conflict of interest.

References

1. Gallardo JM, Gomez-Lopez J, Medina-Bravo P, et al. Maternal Obesity Increases Oxidative Stress in the Newborn. Obesity 2015;23:1650–54.
2. Cali AM, Caprio S. Obesity in children and adolescents. J Clin Endocrinol Metab 2008; 93: S31–S36.

3. Martinovic M, Belojevic G, Evans GW, et al. Prevalence of and contributing factors for overweight and obesity among Montenegrin schoolchildren. Eur J Public Health 2015; 25(5):833–9.
4. Bawadi HA, Khader YS, Haroun TF, Al-Omari M, Tayyem RF. The association between periodontal disease, physical activity and healthy diet among adults in Jordan. J Periodontal Res 2011; 46 (1): 74–81.
5. Hilgers KK, Akridge M, Scheetz JP, Kinane DE. Childhood obesity and dental development. Pediatr Dent 2006; 28: 18–22.
6. Alm A. On dental caries and caries-related factors in children and teenagers. Swed Dent J 2008; 195: 7–63.
7. Hong L, Ahmed A, McCunniff M, Overman P, Mathew M. Obesity and dental caries in children aged 2-6 years in the United States: National Health and Nutrition Examination Survey 1999-2002. J Public Health Dent 2008; 68: 227–33.
8. Centers for Disease Control and Prevention (CDC). Overweight and obesity. Basics about childhood obesity. Available from: https://www.cdc.gov/obesity/childhood/defining.html; 2015.
9. World Health Organization. Oral Health Surveys. Basic Methods, 5th edn. Geneva: World Health Organization, 2013.
10. Greene JC, Vermillion JR. The Simplified Oral Hygiene Index. J Am Dent Assoc 1964; 68: 7–13.
11. EUROSTAT—Income, Social Inclusion and Living Conditions. http://epp.eurostat.ec.europa.eu/portal/page/portal/income_social_inclusion_living_conditions/introduction [updated September 25, 2013].
12. De Jong-Lenters M, van Dommelen P, Schuller AA, Verrips EHW. Body mass index and dental caries in children aged 5 to 8 years attending a dental paediatric referral practice in the Netherlands. BMC Res Notes 2015; 8:738.
13. Sanchez-Perez L, Irigoyen ME, Zepeda M. Dental caries, tooth eruption timing and obesity: a longitudinal study in a group of Mexican schoolchildren. Acta Odont Scand 2010; 68: 57–64.
14. Guven Polat G, Cehreli SB, Tascilar ME, Akgun OM, Altun C, Ozgen T. The oral health status of healthy and obese children in a Turkish population: a cross-sectional study. Turk J Med Sci 2012; 42 (6): 970–976.
15. Marković D, Medić RD, Vučić V, et al. Association between being overweight and oral health in Serbian schoolchildren. Int J Paediatr Dent 2014; 1–10.
16. Sohn W. Obese or overweight children do not have a higher risk of dental caries. J Evid Based Dent Pract 2009; 9: 97–98.
17. Hayden C, Bowler JO, Chambers S, et al. Obesity and dental caries in children: a systematic review and meta-analysis. Community Dent Oral Epidemiol 2013; 41(4): 289–308.
18. Willerhausen B, Blettner M, Kasaj A, Hohenfellner K. Association between body mass index and dental health in 1,290 children of elementary schools in a German city. Clin Oral Investig 2007; 11: 195–200.
19. Burt BA, Pai S. Sugar consumption and caries risk:a systematic review. J Dent Educ 2001; 65: 1017–1023.
20. Touger-Decker R, van Loveren C. Sugars and dental caries. Am J Clin Nutr 2003; 78: 881–892.
21. Janković S, Ivanović, M, Carević M, Davidović B, Tomić S, Lecic J. Relationship between Increased Body Weight and Oral Health in Children. Vojnosanit Preg 2018. 75(12): 1197–1201.
22. Nakhostin A, Meighani G, Abbasi A, Shamshiri AR. The Correlation between Body Mass Index and Oral Health in 12-Year-Old Students in Tehran During 2011. Avicenna J Dent Res 2016; 8(3):7–7.
23. Irigoyen-Camacho ME, Sanchez-Perez L, Molina-Frechero N, Velazquez-Alva C, Zepeda-Zepeda M, Borges-Yanez A. The relationship between body mass index and body fat percentage and periodontal status in Mexican adolescents. Acta Odontol Scand 2014; 72: 48–57.
24. Kesim S, Çiçek B, Aral CA, Öztürk A, Mazıcıoğlu MM, Kortoglu S. Oral Health, Obesity Status and Nutritional Habits in Turkish Children and Adolescents: An Epidemiological Study. Balkan Med J 2016; 33(2):164–72.

Correspondence
Mirjana Đuričković
University of Montenegro, Faculty of Medicine - Department of Dentistry,
Kruševac bb, Podgorica, Montenegro
E-mail: miradjurickovic@gmail.com