

Association between Oral Health and Body Mass Index among Schoolchildren

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ABSTRACT

Aim and objective: This study aimed to investigate the association of oral health by body mass index (BMI) among schoolchildren of Kosovo.

Materials and methods: A comparative-descriptive study was conducted using a sample of 270 children of age group 12–14 years, of both genders, who were selected from various schools along with Kosovo. A questionnaire was used to obtain information on children's demographic characteristics, oral hygiene practices, and dietary habits. Their parental education levels, family incomes, and leisure time activities were also obtained by questionnaire at recruitment. Clinical outcomes were assessed according to the Decayed/Missing/Filled Teeth (DMFT) index and the oral hygiene index-simplified (OHI-S). Adjusted for age, gender, height, and weight, BMI-age percentiles were calculated using the BMI Percentile Calculator for Child and Teen, and children were classified as underweight, normal, overweight, and obese considering age and sex. In the statistical analysis, differences between categorical variables were tested with the Chi-square test (χ^2) and contingency tables.

Results: Caries was present in 47.4% of children. A maximum number of caries affected children belonged to the healthy weight and obesity group, followed by overweight, and the least number was underweight ($p < 0.003$). We found a significant difference between DMFT ($p < 0.02$) and OHI-S values ($p < 0.002$) and BMI-age percentiles subgroups.

Conclusion: The results show a difference in outcomes between DMFT and OHI-S values among BMI-age percentiles subgroups in schoolchildren. Children aged 12 years, from the obese category, had more cases with higher DMFT (significant difference $p < 0.003$), and also more cases with the high OHI-S value were detected among children from the obesity subgroup ($p < 0.002$).

Clinical significance: Obesity, oral health, and dental caries have common risk determinants and require a comprehensive multidisciplinary approach to children by both medical and dental healthcare professionals.

Keywords: Caries, Obesity, Oral health, Physical activity, Schoolchildren.

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INTRODUCTION

Obesity is chronic, global epidemic disease, increasing in many countries around the world.¹ It is mainly caused by regularly consuming more calories from food and drink than the body uses, and low physical activity.² Staying on the smartphone, using a computer, and playing video games take a lot of leisure time away from children, avoiding their physical activity. This lifestyle expends little energy, and during this time, children consume high-calorie foods and drinks,³ and these are the main causes of being overweight or obese.⁴

There is a piece of evidence supporting an association between overweight and oral health in children.⁵ Many scientific studies have revealed a high level of dental caries and gingival inflammation in overweight and obese children.⁶ Dental caries is the most prevalent oral disease and is the main dental public health problem in schoolchildren.⁷ Dental caries may be depending on oral hygiene, fluoride intake, cariogenic diet, lifestyle factor, and host factors (salivary flow, buffer capacity, and buccal microflora),⁸ presence of abnormalities or enamel defects.⁹

Except for these factors, low income, low socioeconomic status, low level of parents' education, are also risk factors for periodontal disease and caries.¹⁰

However, there have been little researches in Kosovo assessing oral health, the prevalence of dental caries, lifestyle factors in relation to obesity. This cross-sectional study was designed to assess the prevalence of dental caries and oral health in relation to obesity in 12- to 14-year-old children attending public schools in Kosovo.

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The objective of this study was to investigate the relationship between dental caries, oral health by body mass index (BMI) among schoolchildren of Kosovo.

MATERIALS AND METHODS

Subject's Enrollment

This cross-sectional study was conducted in Kosovo. Three public elementary schools from three municipalities were randomly

selected. Ethical approval for the study was obtained from the Ethics Committee of the University of Prishtina. Children with obvious diseases or physical, mental deformities, diabetes mellitus, or other systemic illnesses were excluded from the sample. The children/parents who were not willing to participate were excluded also. Children aged 12–14 years from those schools were invited to participate in this study. Among 1,620 children, 270 (16.6%) were recruited, and written informed consent was obtained from the parents of all children who participated in the study. The recruitment took place between January 2019 and March 2019, and the data collection was conducted between April 2019 and July 2019. Finally, 270 (128 girls and 142 boys) pre-adolescents were included in this study.

The data collection consisted of three parts: a dental examination, anthropometric assessments (measuring body height and weight), and completion of a questionnaire.

Questionnaire

A standardized questionnaire was administered to the parents/guardians and was used to determine information on the following: children's demographic and socioeconomic characteristics (their parental education levels, family incomes), children's oral health practices (i.e., toothbrushing frequency; use of fluoride paste, child's last dental visit), dietary habits (nutritional cariogenic intake), and physical activities of the subjects. Children who exercised at least three times a week for more than 1 hour regularly, were considered to be physically active.

The questionnaire included nine questions in the open/close form, three of which required only "yes or no" answers, and six optional questions inviting longer answers.

Anthropometric Assessments

Adjusted for age, gender, height, and weight BMI-age percentiles were calculated using the BMI Percentile Calculator for Child and Teen based on the Centers for Disease Control (CDC) growth charts for children and teens (<https://www.cdc.gov/healthyweight/bmi/calculator.html>). The children, wearing school uniforms, were weighed and had their height measured in bare feet, on a standard balance beam scale. Children were classified into four categories using age- and gender-specific criteria recommended by the CDC:¹¹ underweight—less than 5th percentile; normal weight—5th percentile to less than 85th percentile; at risk of overweight—85th to less than 95th percentile.

Dental Examination

The oral examinations were conducted by a single examiner under natural light with dental instruments, seated in a regular school chair. Dental caries assessments were carried out using criteria recommended by the World Health Organization (WHO).¹² The Decayed, Missing and Filled Teeth (DMFT) index was used to record the caries status of the permanent dentition. Debris and calculus were assessed by oral hygiene index-simplified (OHI-S) according to Green and Vermillion.¹³

The data were collected by a trained researcher.

Statistical Analysis

The categorical variables were summarized as frequency (*n*) and percentages (%). In the statistical analysis, differences between categorical variables were tested with the chi-square test (χ^2) and contingency tables. All statistical analyzes were performed using

the Statistical Package for Social Science SPSS 22.0. Statistical significance was established at the $p < 0.05$ level.

RESULTS

A total of 270 schoolchildren (142 male and 128 female) aged 12–14 years of both genders, selected randomly from different schools along Kosovo were part of the study. Ninety-one were children aged 12 years, 87 aged 13 years, and 92 aged 14 years. Table 1 shows the distribution by gender, age, income, parental education, and regular physical activity within the sample. Also, the prevalence of some characteristics of the study population related to oral health are shown in Table 1, like a visit to a dentist, teeth brushing, sweet eating habits, using fluoride paste, caries, DMFT, BMI-age percentiles, and OHI. In addition, there were no significant differences between the groups in the variable rates, such as gender, age, visits to the dentist, teeth brushing, caries, and regular physical activity ($p > 0.05$), except for family income, parental education, using fluoride paste, sweet eating habits, BMI-age percentiles, DMFT, and OHI score ($p < 0.001$) (Table 1).

Table 2 provides the prevalence of DMFT value in each BMI-age percentile subgroup, based on age. Children aged 12 years, from the obese category (40%), had more cases with higher DMFT compared to other categories (significant difference $p < 0.003$), while children aged 13 years and 14 years, from the category of children with normal weight, had more cases with higher DMFT (48%, respectively, 43.8%) compared to other categories, but without significant difference ($p < 0.217$, respectively, 0.382).

The DMFT value prevalence of children according to BMI subgroup are shown in Table 3. We found a significant difference ($p < 0.02$) between DMFT values and BMI-age percentiles subgroups. In the groups including healthy (43.1%) and obese (36.1%) children, more cases with high values of DMFT were identified.

Caries prevalence of study sample according to BMI-age percentiles subgroups are shown in Table 4. A maximum number of caries affected children belonged to the healthy weight ($n = 52$, 40.6%) and obesity group ($n = 47$), followed by overweight ($n = 27$), and the least number was underweight ($n = 2$). These differences were statistically significant (Chi-square test, $p < 0.003$).

The statistical analysis shows a significant difference in OHI-S index between the BMI-age percentiles subgroup. More cases with the high OHI-S value were detected among children from the obesity subgroup ($n = 7$, 41.2%) ($p < 0.002$) (Table 5).

DISCUSSION

This study has assessed the relationship between BMI-age percentiles and children's oral health. We gained further insight that an inactive way of life, low physical activity, and unhealthy dietary patterns could lead to poor oral hygiene statuses and increase the tendency to develop dental caries and obesity at young ages.²

The high prevalence of dental caries in schoolchildren is a serious health concern. The overall dental caries prevalence in our study sample was 47.4% ($n = 128$). The caries data attained in our study are comparable. It is similar to a study of Yao et al.¹⁴ where the entire prevalence of dental caries was 44.9% and with studies conducted in China¹⁵ and Spain¹⁶ where the average prevalence of dental caries was 41.15%. Additionally, in two other studies, one done by Goodarzi et al.¹⁷ nearly 47% of children, and another done by Bhayat et al.¹⁸ 49% of children had dental caries. Research

Table 1: The characteristics of the study population

Variable	Frequency (n)	Percentage	p
Sex			
Male	142	52.6	0.394
Female	128	47.4	
Age (years)			
12	91	33.7	0.925
13	87	32.2	
14	92	34.1	
Income			
Low	43	15.9	<0.001
Middle	146	54.1	
High	81	30.0	
Parental education			
Primary school	49	18.1	<0.001
Secondary school	165	61.1	
University	56	20.7	
Last year visit to the dentist			
Yes	145	53.7	0.224
No	125	46.3	
Teeth brushing			
Once a day	132	48.9	0.715
Twice a day or more	138	51.1	
Fluorine paste			
Yes	101	37.4	<0.001
No	169	62.6	
Caries			
Yes	128	47.4	0.394
No	142	52.6	
Regular physical activity			
Yes	138	51.1	0.715
No	132	48.9	
Sweet eating habits			
Often	94	34.8	<0.001
Rare	115	42.6	
Sometimes	61	22.6	
BMI percentile			
Underweight	9	3.3	<0.001
Healthy weight	108	40.0	
Overweight	77	28.5	
Obesity	76	28.1	
DMFT			
0	64	23.7	<0.001
1–5	134	49.6	
>5	72	26.7	
OHI			
1	64	23.7	<0.001
2	117	43.3	
3	72	26.7	
4	17	6.3	

BMI, body mass index; OHI-S, oral health index-simplified
The scores of 0 to 1 were classified as low and of 2 to 3 as high oral hygiene index (OHI-S)

in Italy¹⁹ for 12-year-old children suggests that caries prevalence was 61.6% that is higher than the levels found in the present study. Moreover, in a study,²⁰ the prevalence of dental caries was high, with 84.9% of the examined children affected. However, according to a different study,²¹ the caries prevalence has turned out even lower (27%).

In our study, the prevalence of caries was highest among healthy children (40.6%) and obese children (36.7%). Risk factors, such as, poor dental hygiene, foods high in sugar, beverages, and reduced saliva production, often promote bacterial growth as well as the manifestation of caries. Equally, in a study,²² in public schools, the caries prevalence among the obese group was 50.9% and among those of normal weight, 52.4%.

Recent studies have shown a high level of dental caries is associated with obese children.^{23,24} Willershausen et al.²⁴ showed that 842 elementary schoolchildren, aged 6–11 years, whose weight was normal had significantly fewer caries in their deciduous and permanent teeth than the overweight children. In contrary to our research, the obese children had a lower caries index.²⁵ However, a large number of studies have identified that no relationship was found between dental caries and obesity.^{26–28}

In the present study, normal-weight children had a significantly higher DMFT value and prevalence of caries compared to the overweight and obese children. A lower DMFT index was detected in the overweight and obese children, compared with children with a healthy weight ($p < 0.02$). This finding is similar in results compared to two previous studies.^{18,25} Likewise, data from the study,²⁹ carried out in 2- to 17-year-old participants, identified an inverse association: overweight children had lower levels of dental caries than children in the normal BMI category.

We found that 12-year-old obese children had higher DMFT values, while among those aged 13 and 14 years we did not find a significant difference between DMFT values and BMI subgroups.

Contrary in a few studies,^{16,30} there was no significant correlation between BMI and DMFT in any of the age groups (6, 12, 15-year-old)¹⁶ and no statistical difference in DMFT score between obese and non-obese children, 6–17 years old.³⁰

Meanwhile, in our study, the children with normal weight had significantly more dental caries in their permanent teeth, than the overweight and obese children did. This is in opposition with a few certain studies on other groups of children and adolescents, who found that heavier children had more dental caries lesions than those in normal-weight groups.^{24,31,32} Contrary to the present study, an inverse association between caries and BMI was demonstrated. Children with malnutrition were more likely to develop dental caries than those with normal weight or high BMI.¹⁵ However, the results of other studies did not correlate with BMI categories and the prevalence of dental caries.²²

This study aimed to examine a possible association between OHI-S and BMI-age percentiles subgroups, we report that there was a significant difference in obese children who had higher OHI-S ($p < 0.002$). Likewise, a positive association was found between obesity and oral health status in children, conducted in India.²⁶ They have concluded statistically significant ($p < 0.01$) positive correlations between BMI and OHI-S ($r = 0.028$). In relation to the two above studies, the study conveys that the higher value of OHI-S in obesity subgroup children could be explained by them adopting low-intensity physical activities together with consuming high-energy value food.³³



Table 2: The prevalence of DMFT value in each BMI subgroup based on age

Age	DMFT	Underweight, n (%)	Healthy weight, n (%)	Overweight n (%)	Obesity, n (%)	p
12 years	0	3 (9.4)	5 (15.6)	15 (46.9)	9 (28.1)	0.003
	1-5	0 (0)	22 (50.0)	7 (15.9)	15 (34.1)	
	>5	0 (0)	5 (33.3)	4 (26.7)	6 (40.0)	
13 years	0	1 (5.9)	6 (35.3)	8 (47.1)	2 (11.8)	0.217
	1-5	1 (2.2)	18 (40.0)	15 (33.3)	11 (24.4)	
	>5	0 (0)	12 (48.0)	4 (16.0)	9 (36.0)	
14 years	0	0 (0)	6 (40.0)	4 (26.7)	5 (33.3)	0.382
	1-5	2 (4.4)	20 (44.4)	15 (33.3)	8 (17.8)	
	>5	2 (6.3)	14 (43.8)	5 (15.6)	11 (34.4)	

BMI, body mass index

Table 3: The prevalence of DMFT value according to BMI subgroup

DMFT	Underweight, n (%)	Healthy weight, n (%)	Overweight, n (%)	Obesity, n (%)	p
0	4 (6.3)	17 (26.6)	27 (42.2)	16 (25.0)	0.02
1-5	3 (2.2)	60 (44.8)	37 (27.6)	34 (25.4)	
>5	2 (2.8)	31 (43.1)	13 (18.1)	26 (36.1)	

BMI, body mass index

Table 4: The prevalence of dental caries according to BMI subgroup

Caries	Underweight, n (%)	Healthy, weight n (%)	Overweight, n (%)	Obesity, n (%)	p
Yes	2 (1.6)	52 (40.6)	27 (21.1)	47 (36.7)	0.003
No	7 (4.9)	56 (39.4)	50 (35.2)	29 (20.4)	

BMI, body mass index

Table 5: The prevalence of OHI according to BMI subgroup

OHI	Underweight, n (%)	Healthy weight, n (%)	Overweight, n (%)	Obesity, n (%)	p
0	4 (6.3)	28 (43.8)	25 (39.1)	7 (10.9)	0.002
1	2 (1.7)	46 (39.3)	39 (33.3)	30 (25.6)	
2	3 (4.2)	29 (40.3)	8 (11.1)	32 (44.4)	
3	0 (0)	5 (29.4)	5 (29.4)	7 (41.2)	

BMI, body mass index; OHI-S, oral health index-simplified

The scores of 0 to 1 were classified as low and of 2 to 3 as high oral hygiene index (OHI-S)

These findings agree with those of Larsson et al.,³⁴ who showed that children with higher OHI-S values tended to be obese.

A study done in India² reported that there is a strong association of lifestyle factors with oral hygiene in pre-adolescent children. A sedentary lifestyle, with more leisure activities, hurts the oral health of children. Another study³⁵ shows a high prevalence of dental caries, poor oral hygiene, and increased BMI was associated with television viewing habits of children.

Children and adolescents should do 60 minutes or more of physical activity every day. Most of the 60 minutes should be either moderate or vigorous-intensity aerobic physical activity and should incorporate vigorous-intensity physical activity at least 3 days per week.

Several studies have consistently demonstrated that low levels of parental occupation, lack of education, and household income, as well as reduced dental care, are reflected in poor oral health outcomes in children.^{20,36,37} We have likewise noticed these characteristics among our subjects, significant differences were noticed between the study groups. These differences incorporate income, parental education, fluoride paste, and sugar intake. In a study²² conducted in Brazilian adolescents who attend public

schools are usually from poor families and present higher levels of dental caries and a greater need for treatment. Dietary intake, particularly that including high sugar, is an established common risk factor for both dental caries and weight gain,¹⁴ along with socioeconomic status being the second leading factor.²⁸

Limitations

Due to its comparative descriptive design and small sample size, our study was subsequently limited; however, some significant conclusions became apparent. In addition, several variables related to dental caries, such as, oral hygiene and frequency of sugar intake, were controlled for, which expanded the logical limit of the models.

CONCLUSION

Bearing in mind that the population of Kosovo, a country characterized by chronically underfunded health services, lacked universal health coverage and insufficient health indicators compared to other countries in the region and throughout Europe, our study results show high dental caries burdens, as well as a difference in outcomes between DMFT and OHI-S

values among BMI-age percentiles subgroups in schoolchildren. Dentists, pediatricians, and physiatrists should consider the complex relationships between nutrition, physical activity, and oral health by providing the best services to solve these children's health problems. Therefore, it is important to proceed with further research as regards oral health, obesity, and physical activity.

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