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ORIGINAL RESEARCH ARTICLE

Evaluation of Tooth Development, Tooth Eruption, and Dental Caries Formation for Different Body Mass Index Status in Childhood: A Cross-sectional Study

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Abstract

Purpose: The aim of this cross-sectional study was to evaluate tooth development, tooth eruption, and dental caries formation for different body mass index status regarding the development of dental tissues and dental health problems.
Materials and Methods: One-hundred-seventy-six children, aged between 3-12 years old, were included in the study and distributed into 4 groups (n:44) according to their body mass index as underweight, healthy, overweight, and obese. Data on tooth development, tooth eruption, and dental caries were recorded by using modified Demirjian classification, Carvalho classification, and decayed-missing-filled-tooth index (dmft), respectively. $p<0.05$ was accepted as significant.
Results: According to the results, dmft was significantly higher in children with underweight than overweight and obese whereas, whereas earlier tooth eruption was seen in children with healthy and obese than underweight ($p<0.05$). However, there was no statistically significant difference between BMI status for tooth development ($p\geq 0.05$).
Conclusions: Dental caries was higher in children with underweight while tooth eruption was earlier in children with obesity Therefore, general practitioners or pediatricians should be aware of the oral effects of obesity or underweight and consult a pediatric dentist.

Key words: dental caries; malnutrition; pediatric obesity; tooth development; tooth eruption

Introduction

Oral and dental health is greatly affected by daily food intake, such as high-energy foods and beverages specially including carbohydrates, and this also plays an important role in the development of overweight and obesity.[1] Overweight and obesity can be defined as the increased amount of fat stored in the body and the ratio of weight to height square, which is called body mass index (BMI), can be used to define the status as obese, overweight, healthy and underweight.[2,3] The BMI status of children is classified according to percentile ratios.[2] Childhood obesity has increased dramatically in many countries around the world and become a national health problem for specially developing countries and paves the way for adulthood obesity.[4] Even though, prevalence of patients with overweight, and obesity increased with the development of food industry, there are still children with underweight whom often malnourished.[3] The first signs of these might be seen during dental visits with clinical and radiographical evaluation and they differ according to being overweight or underweight. Dental problems such as enamel hypoplasia, salivary gland hypofunction and changes in saliva composition might occur because of being underweight, these findings may also be considered as symptoms that associates malnutrition with dental caries.[5,6] Also, the incidence of malocclusion tent to increase considerably as well as obesity than primitive societies.[7] This occurs because of the decrease in chewing forces, and the consumption of refined soft foods and premature loss of primary teeth due to the dental caries.[5–8] Therefore, the null hypothesis of this study was that there was no difference between different body mass index status regarding tooth development, tooth eruption, and dental caries formation. So, the aim of this study was to evaluate tooth development, tooth eruption, and dental caries formation between children with different BMI status such as obese, overweight, healthy, and underweight.

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Material and Methods

Ethical and priori statistical considerations

Procedures followed during the study were in accordance with the Helsinki Declaration, written consents were taken, and the study was approved by Başkent University Institutional Review Board with the number D-KA18/32. In this study, 176 healthy child-patients aged between 3-12 years old were included and classified as underweight, healthy, overweight, and obese according to their BMI, and the study was continued to include 44 patients in each group with a power of at least 90% at the 5% significance level and 0.3 effect size. Children with systemic disease such as cardiac disease, neurologic disease, developmental and growth problems, or hormonal dysfunctions such as diabetes mellitus, hypothyroidism were excluded from the study.

Study design

This study was conducted as a cross-sectional study for the evaluation of tooth development, tooth eruption and dental caries formation for children with obese, overweight, healthy and underweight. The height and weight of the children were measured with an electronic height- weight scale (Seca GmbH & Co. kg, Hamburg, Germany) to calculate the BMI for each child. The BMI of the participating children was classified by using percentile curves prepared by World Health Organization for children according to age and gender.[2] After BMI measurement all dental data was recorded using a form during the clinical examination by a different pediatric dentist who was unaware of the group distribution of participating children in pediatric dentistry clinic in Başkent University.

Variable measurements

During the clinical examination, dental caries formation, tooth development and tooth eruption were recorded according to their indexes. The decay-missing-filled-tooth (dmft) index, which determines according to the calculation of caries, extracted and restored teeth and use to define the prevalence of caries, was recorded to determine the occurrence of dental caries formation.[8,9] Tooth development and tooth eruption were scored by using modified Demirjian et al. classification and Carvalho et al. classification, respectively.[10–13] According to the modified Demirjian classification, there are 9 stages of tooth development starting with the beginning stage of follicle development as a radiolucent bud with no calcification (Stage 0), calcification of cusp tips without coalescence (Stage A), and continue with coalescence of the mineralized cusp tips with recognizable coronal morphology (Stage B), formation of nearly half of the crown and beginning of dentin deposition (Stage C), complete crown formation up to cementoenamel junction (Stage D), root length shorter than the crown height (Stage E), root length equal or greater than the crown height (Stage F), complete root formation with open apical foramen (Stage G) and complete closure of apical root end (Stage H).[11–13] Carvalho classification was modified to represent the unerupted first permanent molar teeth for children with an age of <6 years old.[10] So, according to the Carvalho classification 5 eruption stages were evaluated which were; G0: Not erupted, G1: Partially erupted one tooth, G2: More than one tooth was partially erupted, but more than half of the facial surfaces were covered with gingival tissue, G3: More than one tooth was partially erupted, but less than half of the facial surfaces were covered with gingival tissue, G4: Full occlusion for more than one year.[10]

Statistical analysis

The data obtained in this study were analyzed using the SPSS 21 package program. Mean, standard deviation and percentages were used for descriptive statistics. Quantitative variables such as age and dmft were given as mean and standard deviation. Age was analyzed with ANOVA due to normal distribution analyzed with Shapiro Wilk and skewness and kurtosis values, while dmft was analyzed with Kruskal Wallis-H Test with Mann-Whitney U Test as pairwise comparisons. Gender, education level and family income level were given as percentages and the association between these categorical variables was examined by Chi-Square analysis. In case of significance results for gender, education level and family income level, pairwise comparisons were analyzed with Independent T-Test after the evaluation of normality with Shapiro Wilk and skewness and kurtosis values. $p<0.05$ was accepted as statistically significant.

Results

According to the obtained data, demographic data such as age, gender, parental education level and family income levels of the participating children in underweight, healthy, overweight, and obese groups are given in Table 1. Gender distribution was statistically significant for different BMI status ($p=0.011$; Table 1). There was statistically significant difference between overweight and underweight ($p=0.005$; $p<0.05$), obese and underweight ($p=0.002$; $p<0.05$) and healthy and underweight ($p=0.017$; $p<0.05$) while there was no difference between overweight and obese ($p=0.830$; $p\geq0.05$), overweight and healthy (0.671; $p\geq0.05$) and obese and healthy (0.523; $p\geq0.05$). In terms of BMI status of participating children, there was not any significant difference between parental education levels ($p=0.058$; Table 1) however, underweight children percentage was higher (42.1%; Table 1) with parents with less than 8 years of education. There was statistically significant difference between the groups in terms of dmft index ($p=0.023$; Table 2). dmft scores are significantly higher in participants with underweight than overweight ($p=0.021$; Table 2) and obese ($p=0.026$; Table 2). However, there was no statistically significant difference between BMI status for tooth development ($p=0.268$; Table 3). There was statistically significant association for tooth eruption and according to the Carvalho's classification G0, G1 and G2 were higher in participants with underweight while G3 and G4 was higher in participants with healthy and obese, respectively ($p=0.002$; Table 3).

Discussion

The most important factors in childhood obesity are the dietary habits of children and they are directly related with dental health specially caries development. In this case, clinical examination specially at first dental visit is very important step to diagnose and prevent future dental problems.[1,3,5] According to the previous studies, the impact of higher or lower BMI on oral and dental tissues are not clear and therefore the aim of this study was to evaluate the impact of BMI status of the child on caries development, tooth development and tooth eruption.[5,7,8] Besides, it should also be noted that these clinical findings might be the result of oro-dental development nearby the dental health problems caused by different BMI conditions, especially obesity and underweight. First of all, the primary reason of obesity and dental caries is assumed as bad dietary habits for children without any systemic or physical disease or disfunction in the literature.[1,3] However, the results of the previous studies on the association between BMI and dental caries development showed controversial results.[14–22] While some of these studies showed the association between dental caries and higher BMI,[14,17,18,22] some studies showed an inverse relationship between BMI and development of tooth caries, or with the other

Table 1. Demographic data of the participating children for each group regarding BMI status

	BMI status										
	Underweight		Healthy		Overweight		Obese		Total		
	n	Mean±sd	n	Mean±sd	n	Mean±sd	n	Mean±sd	n	Mean±sd	ANOVA p-value
Age (years)	44	6.74±2.02	44	6.66±1.76	44	5.74±2.31	44	6.45±2.27	176	6.40±2.12	0.107
	n	%	n	%	n	%	n	%	n	%	Chi-Square p-value
Gender											
Female	31	36.0	20	23.3	18	20.9	17	19.8	86	100.0	0.011*
Male	13	14.4	24	26.7	26	28.9	27	30.0	90	100.0	
Education level											
<8 years	8	42.1	7	36.8	3	15.8	1	5.3	19	100.0	
≥8 years	36	22.9	37	23.6	41	26.1	43	27.4	157	100.0	0.058
Family income level											
<Min wage	4	50.0	2	25.0	1	12.5	1	12.5	8	100.0	0.525
≥Min wage	40	23.8	42	25.0	43	25.6	43	25.6	168	100.0	

Table 2. dmft scores of the participating children regarding different BMI status

BMI status	dmft scores					Kruskal Wallis-H Test	Mann-Whitney U Test
	n	Mean±sd	Median (p25-p75)	Min	Max	p-value	Pair-wise comparison
Underweight	44	17.9±12.3	16.0	0.0	44.0	0.023*	Underweight-Healthy; p = 0.128 Underweight-Overweight; p = 0.021*
Healthy	44	14.1±10.0	14.0	0.0	42.0		
Overweight	44	11.2±11.3	8.5	0.0	39.0		Underweight-Obese; p = 0.026* Overweight-Healthy; p = 0.190
Obese	44	12.1±11.1	11.5	0.0	39.0		Overweight-Obese; p = 0.680 Healthy-Obese; p = 0.303
Total	176	13.8±11.4	14.0	0.0	44.0		

Table 3. The association between different BMI status of participating children regarding tooth development and eruption

		BMI status										
		Underweight		Healthy		Overweight		Obese		Total		Chi-Square analysis
		n	%	n	%	n	%	n	%	n	%	p-value
Tooth development	Stage 0	0	0.0	0	0.0	0	0.0	0	0.0	0	0	0.268
	Stage A	0	0.0	0	0.0	0	0.0	0	0.0	0	0	
	Stage B	1	100.0	0	0.0	0	0.0	0	0.0	1	100	
	Stage C	3	50.0	1	16.7	2	33.3	0	0.0	6	100	
	Stage D	7	28.0	8	32.0	3	12.0	7	28.0	25	100	
	Stage E	10	34.5	9	31.0	3	10.3	7	24.1	29	100	
	Stage F	16	25.8	15	24.2	17	27.4	14	22.6	62	100	
	Stage G	5	18.5	6	22.2	8	29.6	8	29.6	27	100	
	Stage H	2	7.7	5	19.2	11	42.3	8	30.8	26	100	
Tooth eruption	G0	18	40.9	13	29.5	6	13.6	7	15.9	44	100	0.002*
	G1	7	33.3	6	28.6	2	9.5	6	28.6	21	100	
	G2	12	26.1	12	26.1	11	23.9	11	23.9	46	100	
	G3	2	6.3	11	34.4	10	31.3	9	28.1	32	100	
	G4	5	15.2	2	6.1	15	45.5	11	33.3	33	100	

terms no relationship at all.[15,16,19–21] In this present study, dmft index was used to assess the number of tooth caries for children with underweight, healthy, overweight, and obese. According to the obtained data, there was statistically significant difference between the BMI status of participating children and dmft index values were significantly higher in participants with underweight than overweight and obese. So, this result does not support the bad dietary habits specially carbohydrates increase the caries development or progression rate. On the contrary, it supports the information about malnourished children might have insufficiency or abnormalities during tooth development which might cause increased caries progression such as enamel hypoplasia, salivary gland hypofunction and changes in saliva composition.[6] Also, lack of appetite in children with underweight causes slow and less chewing function.[14,17] So, we might state that increased chewing time and holding food in the mouth might increase the contact of the tooth surface and food and decrease the cleanability due to low chewing function. Therefore, pediatric dentists should be more aware about the BMI status of the patients and advise protective approaches to prevent development and progression of tooth caries or more tragic scenario such as severe type of early childhood caries. Ignoring racial and ethnic diversity, the increased linear correlation between BMI and tooth eruption was stated in the literature.[23] According to the results of a previous study conducted on the relationship between caries and obesity, earlier tooth development had been seen in children with overweight and obesity.[24] As a result of this, earlier development and inadequate oral hygiene may lead to higher rates of tooth eruption, tooth caries and therefore malocclusion.[25] In the present study, the eruption stages were classified according to the Carvalho et al. and G0, G1 and G2 stages were higher in participants with underweight while G3 and G4 was higher in participants with healthy and obesity, respectively.[10] Besides the earlier eruption, the need for orthodontic treatment may occur at an earlier age due to the earlier eruption than the normal weight peers in children with overweight and obesity. In this study, the results of tooth eruption for each group showed statistically significant difference consistently with the literature. So, the hypothesis of the study was rejected according to the results due to the significant difference determined between different BMI conditions regarding dental caries and tooth eruption. The participating children were selected from healthy children without any systemic disease or drug use in order to prevent developmental differences, and data collection was performed by a different pediatric dentist to reduce the risk of bias. Perhaps the limitations of the study are that the children included in the study were examined only once and distributed to groups and no information was gathered about dental health practices and other risk factors related to the dental caries, tooth development, or tooth eruption. Since the phases of dental development and dental problems such as dental caries and tooth eruption develop over a long time, it can be supported by clinical studies in which patients are followed instead of determining a group with a single appointment.

Conclusion

According to the results of the present study, different status of BMI showed significant results for tooth caries and tooth eruption rather than tooth development. But, considering that the early tooth eruption might be an important reason for ongoing malocclusion development, the need for early preventive treatments should be evaluated in the future. Therefore, general practitioners or pediatricians should consider the oral effects of obesity or underweight and consult to a pediatric dentist. So, further comprehensive observational and clinical studies are needed to state the importance of BMI to take its place in pediatrics and pediatric dentistry guidelines.

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Author Contributions

DSU and BMÖ conceived the idea, designed the study and carried out experiments. DSU analyzed the data and wrote original draft of the manuscript. BMÖ revised the original draft of manuscript and all authors had final approval of the submitted and published versions.

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Conflict of Interest

Authors declare that they have no conflict of interest.

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