Original Article

The Relationship between Body Mass Index and Dental Development in 5 to 6 Years Old Children in Sari

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Abstract:

Introduction: Obesity is one of the major health problems in children due to changes in lifestyle and diet. Obesity in children and adolescents is associated with stature growth, and bone age. In addition, children who are under- or overweigh may be related to changes in tooth eruption. This study aimed to determine the relationship between body mass index (BMI) and number of permanent teeth in children.

Methods: This descriptive cross-sectional study was performed preschool to investigate the 5 to 6 years old children in Sari city from May 2019 to June 2019. The date of birth of children was obtained from the school records on the examination day. The necessary explanations about the study are given to participants and after their consent, the examinations were carried out. SPSS software version 24 was used for statistical analysis and the significance level was considered $p<0.05$.

Findings: A survey of 483 children in preschool centers in Sari showed that BMI had a range of 11.1-27.6 with a median of 15.4 (14.4-16.9). The age, height, weight and BMI were similar between the two sexes ($p>0.05$). According to Phakala criterion, there was no significant difference in the number of permanent teeth and first molars between girls and boys ($p<0.05$). Also, the value of dmft was not significantly different between boys and girls ($p <0.05$). There were statistically significant differences in count of permanent teeth according to the main criterion, dt and mt between the different weight groups ($p=0.047$). In addition, there was a significant correlation between BMI and number of permanent teeth, and dmft value ($p<0.05$).

Conclusion: The results of this study showed that permanent teeth may erupt earlier in obese children, which clarifies the need for periodic dental examinations in this group of children. Also, BMI correlates with permanent teeth eruption and dmft value, so that the more weight gain may be results in the more eruption of permanent teeth and lower dmft values.

Keywords: Overweight, Children, Permanent Tooth, Eruption.

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Introduction:

Obesity is one of the major health problems in children due to changes in lifestyle and diet (1). The World Health Organization (WHO) utilize body mass index (BMI) to classify weight groups, that it is defined as a person's weight in kilograms divided by the square of the person's height in metres (kg/m2) (2). Obesity rate has tripled worldwide since 1975, according to the latest WHO report in 2016, 41 million children under 5 years old and over 340 million children and adolescents aged 5-19 years were overweight or obese (3). In Iran, obesity is also has increasing trend in children (5). A systematic review study in 2016, investigated the prevalence of obesity in Iranian children and adolescents. It was found that various age and sex groups of children had a significant differences in the prevalence of obesity and overweight, which has been increasing in recent decades (4.4-42.3% and 1-16.1% for overweight and obesity respectively) (6). Childhood obesity is associated with many complications, including endocrine (diabetes, hyperandrogenism, and dyslipidemia), cardiovascular, gastrointestinal, pulmonary, orthopedic, neurological, psychological complications, and adulthood obesity and its associated chronic diseases (Diabetes, hypertension, cardiovascular, endocrine, and sleep disorders) (2, 7). Studies have shown that obesity in children and adolescents is associated with stature growth, and bone age. In addition, children who are under- or overweigh may be related to changes in tooth eruption. (1). The eruption of permanent teeth have been found to erupt between the ages of 6 to 12 years, except the third molars which do so between 17 and 21 years (9). Studies have shown that the pattern of permanent tooth eruption varies among individuals (8) and the timing and order of permanent tooth growth is influenced by various factors such as genetics, sex, hormone, social, and geographic region. Tooth eruption is a continuous biological process by which developing teeth emerge through the jaws and the overlying mucosa to enter into the oral cavity (1, 7).

There have been limited studies investigating the relationship between obesity and its possible impact on dental development, and the findings are often contradictory (10, 11). Obese children may experience earlier craniofacial growth, which can alter the diagnosis, treatment plan, and timing of orthodontic treatment. In fact, when orthodontic treatments such as growth correction and sequential extraction are needed, not only may the patient's race and gender be considered but also his or her body mass is important (12). In addition, in the case of premature tooth eruption, especially the first molar tooth, which usually develops at age 6, it requires early dental care to identify caries and fissure sealants (7). In a study of 689 Brazilian children aged 6-16 years, no significant relationship was found between dental development and BMI (10). On the other hand, results of two studies examining 8-15 year-old children showed that being overweight accelerates tooth development, which should be considered in the pediatric orthodontic treatment plan (13, 7). This study aimed to determine the relationship between body mass index and the number of

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permanent teeth in preschool children in Sari, Iran.

Methods:

This descriptive cross-sectional study was performed preschool to investigate the 5 to 6 years old children in Sari city from May 2019 to June 2019. The main purpose of this study was to determine the relationship between BMI and total number of permanent teeth and the first permanent molars (sixth tooth), which are highly important in schemes of normal occlusion, caries prevention and fissure sealant. The study proposal approved by ethics committee of Mazandaran University of medical sciences (IR.MAZUMS.REC.1398.5427). The researchers in coordination with the Education Organization of Sari, referred to selected schools from different areas. At the enrollment, information about the aim of the study were given to children's parents and a written consent was collected from those who agreed to participate. The birth date of the children was obtained from school records and the exact age of the child was determined on the day of the examination. The children were also given the necessary explanations about the plan and if necessary the examinations were carried out on them. Dental examinations were performed by the dentist while the child was sitting on a regular chair with the help of disposable dental mirror, number 3 catheter and flashlight.

For weighing, a standard digital scale (Omron-Germany) was used, which controlled by a 5kg weight. The participants stand in the middle of the scale, with minimal clothing and no shoes and hats and the weight has been recorded. A standard height meter has been used for determining the height of children in a straight position with no shoes or hats while the back, shoulder, hips and back of the legs and heels were perfectly tangent to the caliber and the child was facing forward.

The BMI was calculated by dividing the weight (in kg) by the square of the height (in meters). The WHO BMI by age chart (boy or girl) was used to record BMI as the following items (14):

Underweight (Slim & Very Slim) BMI <-2 Z score

Normal -2 Z score ≤ BMI ≤+1 Z score

Weight gain risk +1 Z score < BMI ≤+2 Z score

Overweight +2 Z score < BMI ≤+3 Z score

Obese BMI > +3 Z score

In this study, the number of permanent teeth was determined according to both main criteria and Phakala criteria (15). In the Phakala criterion, the stages of tooth eruption are calculated as follows:

0: The tooth is not seen in the oral cavity.

1: At least one cusp is found in the oral cavity.

2: The entire occlusal surface is seen in the oral cavity but does not reach the Occlusal Level.

3: The tooth reaches the Occlusal Level.

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In this criterion, stages 0 and 1 are considered as unerupted and stages 2 and 3 are considered as tooth eruption (15).

According to the main criterion of tooth eruption, which is more commonly agreed and easier to estimate, a tooth is considered erupted when crown have perforated any part of the oral mucosa and to be clinically visible. In this case, non-eruption occurs when no part of the crown of the tooth is visible (16).

Also, dmft (Decayed, Missing, Filled teeth) criterion was used to evaluate the health status of primary teeth. In this criterion, decay refers to a tooth that is a lesion created on smooth surfaces or inside tooth grooves that is emptied under the enamel or softened around the floor. Missing refers to a tooth that has been extracted because of caries. Filled teeth refers to a tooth that has been restored due to caries.

Statistical analyses:

Statistical analysis was performed using the Statistical Package for Social Sciences software (SPSS V24, Chicago, IL). Data normality was tested using the Shapiro-Wilk test. Chi-square and Mann-Whitney, Kruskal-Wallis, was also performed. The Pearson and spearman correlation tests was used to verify the correlation between variables. A significance level of $p<0.05$ was used. Data are expressed as the mean and standard deviation (SD). Significance level $p <0.05$ was considered.

Findings:

A survey of 483 children in preschool centers in Sari showed that the age of children were 5.1 to 6.7 years old with a median of 6.1 (5.8-6.3) and the height and weight had a median of 117 (114-121) and 21.1 (19.2-24.1) respectively. BMI had a range of 11.1-27.6 with a median of 15.4 (14.4-16.9). The age, height, weight and BMI were similar between the two sexes ($p>0.05$).

According to Phakala criterion, there was no significant difference in the number of permanent teeth (2.0 (0.0-5.0) vs 2.0 (0.0-4.0) and first molars (1.0 (0.0-4.0) vs 0.0 (0.0-4.0)) between girls and boys respectively ($p>0.05$). (Table 1).

Examination of the distribution of decayed, missed and filled teeth in girls and boys also showed that the decayed teeth (dt) had a median of 4.0 (1.0-6.0) in boys and 4.0 (2.0-6.0) in girls. Primary filled tooth (ft) had a median of 0.0 (0.0-2.0) in boys and 0.0 (0.0-1.0) in girls, and missed primary teeth (mt) had a median of 0.0 (0.0-0.0) in boys and 0.0 (0.0-0.0) in girls. Also, the value of dmft was not significantly different between boys and girls ($p>0.05$).

According to the main criterion, the distribution of permanent teeth and first molars of girls and boys had median (IQR) of 3.0 (0.0-0.6) and 2.0 (0.0-5.0) respectively, and the difference was not statically significant ($P=0.362$). Also, the median of permanent first molar teeth were 2.0 (0.0-4.0) and 2.0 (0.0-4.0) in boys and girls respectively which was not significantly different between two sexes ($P=0.408$).

Categorizing the weight of children by WHO criteria showed that the majority of

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children 349 (72.3%) were normal weight followed by 61 (12.6%) in weight gain risk, 37 (737%) overweight, 25 (5.2%) obese, and 11 (2.3%) underweight. The weight categories of children did not show a significant difference between boys and girls (p=0.323).

Evaluation of the number of permanent and primary teeth based on children's weight group showed that there was no significant difference between different weight groups according to Phakala criterion (p>0.05). In other hand, there were statistically significant differences in count of permanent teeth according to the main criterion, dt and mt between the different weight groups (p=0.047).

In addition, there was a significant correlation between BMI and number of permanent teeth, and dmft value (p<0.05).

Investigation of the relationship between study variables and BMI using Spearman correlation test showed that BMI has positive and significant correlation with number of permanent teeth according to Phakala criterion (r=0.145, p=0.001), number of permanent first molars based on Phakala criterion (r=0.126, p=0.006), number of permanent teeth according to main criterion (r=0.141, p=0.002), and number of permanent first molars according to main criterion (r=0.108, p=0.018) and a negative and significant correlation with the dmft value (r=-0.104, p=0.023). (Table 2).

Discussion:

Evaluation of the number of permanent teeth in various weight groups showed that there was statistically significant differences in number of permanent teeth based on main criteria but not according to Phakala criteria. In addition, the BMI had significant correlation with permanent first molars according to main and Phakala criteria. However the number of permanent teeth according to both main and phakala criteria was not statistically significant between both sexes.

In 2018, Anusha et al (17) conducted a study to determine the relationship between childhood obesity and tooth eruption in Chennai, India. The study was conducted on 400 children and half of them were boys and another half were girls. The eruption of permanent teeth in girls was earlier than boys, and the age of tooth eruption increased with increasing BMI. Furthermore delayed tooth eruption was observed in obese children, which is similar to the results obtained in the present study.

Another study conducted by Sindelarova et al. (7) on the association of obesity with the timing of permanent tooth eruption in Czech children in 2017. In their cross-sectional study 1370 children included, the findings showed that there was a significant relationship between permanent tooth emergence and obesity so that the teeth of obese children develop earlier than normal children. The first molars growth occurred at the ages of 6.77 and 6.42 in normal and obese children respectively (p=0.027). In addition, the study by Must et al. (18) examined information from the National Center for Health and Nutrition Studies (NHANES) 2001-2006 to investigate the relationship between tooth eruption and

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childhood obesity of 5434 children at the ages of 5-14 years. The results showed that obesity was correlated with the number of teeth appearing in the mouth cavity. On average, the teeth of obese children appeared earlier than non-obese children ($p<0.0001$). At the age of 5.0-5.9 years, the number of permanent teeth in obese and non-obese children was 2.1 and 1.2, respectively ($p<0.05$). These findings also confirm the results of the present study.

Another cross-sectional study was conducted by Kutesa et al (1) in 2013 in Kampala, Uganda. In this study 520 boys and 521 girls from two primary schools were included. Generally, the teeth eruption were shorter in girls than boys. The weight of children was significantly correlated with the time of tooth eruption in half of cases. In another study by Heinrich et al. (2013) in the Philippines, 1554 children aged 10-13 years including 711 boys and 843 girls were enrolled. The number of permanent teeth was significantly correlated with BMI. Underweight and growth retarded children had significantly fewer permanent teeth than other children in same ages. They have shown that BMI and abnormal weight have effects on permanent teeth eruption, whcich is consistent with the findings of the present study.

Anbiaee et al. (20) conducted a study to determine the relationship between dental development and BMI of children in Mashhad, Iran. In this study, 196 children was divided into four groups including low, normal, overweight and obese based on BMI. They found that boys in overweight and obese BMI category had a significantly accelerated dental development comparing with boys in normal BMI category which equals approximately to 0.7 years. ($p = 0.018$), while there was no significant difference in girls' BMI ($p = 0.07$). That this difference may be due to demographic and racial differences in the children studied in this study.

The findings of this study are of clinical importance in relation to the risks of dental caries, and malocclusion. Disruption of normal permanent tooth growth can lead to the early appearance of new teeth that can interfere with treatment planning (21). Failure of timely treatment can lead to increased oral problems such as poor occlusion, poor crowding and oral hygiene, and results in further therapeutic interventions in the future (22).

Dental caries are especially important in childhood. There are several factors associated with dental caries including genetic factors, diet, brushing and toothpaste type, socioeconomic status, as well as weight gain and obesity (23). In present study, the frequency of BMI groups were consistent with the results of previous studies (24, 25).

The dmft index in the present study was in agreement to the study of Bahrololoomi et al (26) in Yazd who investigated the relationship between body mass index and dental caries in children in Yazd city, also in their study children at risk of being overweight or overweight had higher caries index than other children ($p<0.001$). In other hand dmft index of present study were lower than finding of studies in Iran, such as the study of Mohtadinia et al. (27) in Tabriz,

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and Mojarad et al (28) survey in Hamadan preschool children. However, the dmft index was higher than some studies elsewhere in the world. Parshnath et al (29) obtained this index at about 2. In the study of Willershausen et al. (24), the index was slightly higher than 2. These results shows a significant difference in the indices available in Iran with other countries.

In the present study, BMI and dmft had inverse correlation. This is constant with the results of Narksawat et al (31) in Thailand and Parshnath et al in India. And, contrary to the findings of Ghasempour et al. (30) in a study in Babol, that find BMI and dmtf had a direct and significant correlation, as well as Bahrololoomi et al. However, some other studies, such as the study by Mohtadyinia et al. (27) and Hong et al. (32) and Granville-Garcia et al. (33) in Brazil, did not find a significant relationship between BMI and dmft index. Many factors affect obesity and tooth decays. As a result, the relationship between them is very complex. In addition, studies in different populations with different racial, nutritional, and environmental characteristics make it difficult to compare their results. On the other hand, factors such as malnutrition, low birth weight, maternal illness, parental education level, and place of residence have roles in enamel defects (36-34).

Conclusion:

The results of this study showed that permanent teeth may erupt earlier in obese children, which clarifies the need for periodic dental examinations in this group of children. Also, BMI correlates with permanent teeth eruption and dmft value, so that the more weight gain may be results in the more eruption of permanent teeth and lower dmft values.

Conclusion:

One of the limitations of this study is the cross-sectional nature that the relationship between the sequence of decay and tooth growth and BMI are not clear. Therefore, the results of this study cannot deduce the causal relationship. Another limitation of this study is the lack of information on dietary habits that may be responsible for obesity and dental caries**.**

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Tables and Charts:

Table 1: Number of permanent teeth and first molars of girls and boys according to Phakala criteria.

Group	Boys		Girls		p-value
	Mean ± SD	Median (IQR)	Mean ± SD	Median (IQR)	
Permanent tooth	(2.7 ±) 2.5	2.0 (0.0 - 4.0)	(2.7 ±) 2.6	2.0 (0.0 - 5.0)	0.587
Permanent first Molar	(1.7 ±) 1.5	0.0 (0.0 - 4.0)	(1.7 ±) 1.6	1.0 (0.0 - 4.0)	0.28

(Mann-Whitney test)

Table 2: Correlation of the variables with BMI.

Variables	BMI	
	r	p-value
Permanent teeth (Phakala)	0.145	0.001
Permanent first molar (Phakala)	0.126	0.006
DT	-0.052	0.251
FT	-0.049	0.28
MT	-0.062	0.173
DMFT	-0.104	0.023
Permanent teeth (main)	0.141	0.002
permanent first molar (main)	0.108	0.018

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