

Association of Body Mass Index with Dental Caries, Tooth Eruption, and Oral Hygiene Status in School-going Children: A Cross-sectional Study

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Abstract

Aim and Objectives: The aim of the study was to evaluate the association of body mass index (BMI) with dental caries, tooth eruption status, and oral hygiene status in school-going children aged 6–12 years in Jaipur. **Materials and Methods:** A random sample of 300 children ($n = 133$ girls and $n = 167$ boys) aged 6–12 years was evaluated. For the study, demographic details and anthropometric measurements consisting height and weight were recorded. BMI was calculated using the World Health Organization (WHO) diagnostic criteria and plotted on the Centers for Disease Control and Prevention-BMI for age growth charts/curves for boys and girls to obtain the BMI percentile. Data regarding dental caries were recorded using the WHO criteria for decayed, missing, and filled teeth (DMFT) index. Teeth present in the oral cavity were recorded and matched with the chronology table according to the age of the child. Oral hygiene status was assessed using the oral hygiene index-simplified. Data obtained were analyzed using STATA/IC-13 software. One-way analysis of variance test was used to determine the statistical significance of DMFT values. Categorical data were analyzed by Chi-square test between two groups. **Results:** Out of 300 children, 22.6% ($n = 68$) were found to be underweight, 56% ($n = 168$) were healthy, 7.3% ($n = 22$) were overweight, and 14% ($n = 42$) were found as obese. A statistically significant association was observed between BMI and teeth eruption status ($P < 0.001$), while no statistically significant association was observed between BMI and dental caries as well as BMI and oral hygiene status. **Conclusion:** BMI was not related to dental caries and oral hygiene status but was significantly associated with the tooth eruption status in children. A very concise amount of literature is present related to BMI and its association with dental caries, tooth eruption, and oral hygiene status. Further studies are required to address the factors affecting BMI and other parameters to assess a more definitive relationship among the above parameters with BMI.

Keywords: BMI, Obesity, Dental Caries, DMFT, Tooth Eruption, OHI-S, Oral Hygiene.

INTRODUCTION

The changing trends in lifestyle have a significant influence on the physical and oral health of a child. Diet, being the foremost factor, has a direct relation with health and body mass index (BMI). The correlation between BMI and oral health conditions is widely available in the literature, as the consumption of sugar and its products has been a part of the human diet. Such correlations and studies show that obesity is not only a systemic issue but also contributes to various oral conditions. This study intended to further understand the BMI and its correlation with oral conditions such as dental caries, its effect on the time of tooth eruption, and oral hygiene status in a child with mixed dentition aged 6–12 years. This age range allows us to access the emergence of different teeth as most of the permanent teeth eruption occurs at this period, and

the initiation of caries in the newly erupted teeth and plaque deposition, concluding oral hygiene.

MATERIALS AND METHOD

In the present study, a total of 300 children aged 6–12 years visiting the department as well as the participants of the school dental health check-up camps and participants of housing

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society camps were enrolled with duly signed consent forms from parents/teachers.

Inclusion criteria

1. Healthy children willing to participate.

Exclusion criteria

1. Children with any systemic illness
2. Children undergoing orthodontic treatment
3. Children with physical and mental disabilities.

The assessment of growth by anthropometric methods of weight, height, and BMI is done to evaluate the growth of the child. History, including demographic details and past medical and dental history, was recorded. The body weight of study subjects was measured using a standardized digital and portable weighing scale, and height was measured to the nearest 0.1 cm using a portable stadiometer. The BMI was calculated using the value obtained from the body weight and height (kg/m^2) of each child. The results were plotted on age and gender-specific Centers for the Disease Control and Prevention-BMI percentile curves and categorized according to the BMI percentiles acquired from the chart. After the physical examination was done, intraoral examination was carried out under natural light using diagnostic instruments. For dental caries, DMFT scores were calculated, and the data obtained were recorded in the format for DMFT in the study format. Regarding tooth eruption, each tooth present in the oral cavity was recorded, and dental age was estimated. Oral hygiene status was assessed using the simplified oral hygiene index (OHI-S). The scores were calculated, and the data obtained were recorded in the format for OHI-S in the study format.

Statistical analysis

A master chart was created using Microsoft Excel for the purpose of data analysis. Descriptive statistics that included mean, frequencies along with standard deviations, and percentages were calculated. The data were analyzed using STATA/IC-13 software. One-way analysis of variance (ANOVA) test was used to determine the statistical significance of DMFT values. Pearson's Chi-square test was used to check the association of BMI with gender, eruption stage, and oral hygiene status. Statistical significance for all tests was predetermined at a probability value (P -value) of 0.05 or less.

OBSERVATIONS AND RESULTS

This cross-sectional study was conducted to evaluate the association of BMI with dental caries, tooth eruption status, and oral hygiene status in school-going children in Jaipur aged 6 to 12 years. The study population consisted of children who were included underweight, healthy, overweight, and obese subjects.

A total of 300 children were evaluated in this study, in which 44.3% ($n = 133$) were girls and 55.7% ($n = 167$) were boys.

Data represents that out of 300 children, 22.6% ($n = 68$) were found to be "Underweight," 56% ($n = 168$) were "Healthy," 7.3% ($n = 22$) were "Overweight," and 14% ($n = 42$) were found as "Obese."

Data show that out of 300 children 66% ($n = 198$), DMFT score was recorded as "0" as their permanent teeth showed no dental caries while 34% ($n = 102$) showed ≥ 1 DMFT score which signifies dental caries in their permanent teeth.

Out of 300 children, 30% ($n = 90$) showed delayed tooth eruption stage, 13% ($n = 39$) showed early eruption sequence, and a majority of 57% ($n = 171$) showed normal/timely eruption status of their teeth.

Out of 300 children, 33.7% ($n = 113$) manifested fair oral hygiene, 53.3% ($n = 160$) manifested good oral hygiene, and only 9% ($n = 27$) showed poor oral hygiene.

Table 1 represents the BMI and its correlation with DMFT scores by applying one-way ANOVA test. The $P = 0.294$ was recorded that is >0.05 which is statistically insignificant. Hence, in this study, BMI was not associated with dental caries status in children.

Table 2 shows the relation between BMI and teeth eruption status in children.

Out of 68 underweight children, 35.5% ($n = 24$) showed delayed eruption, 17.6% ($n = 12$) showed early eruption, and 47.1% ($n = 32$) showed normal eruption status in children.

Out of 168 healthy children, 22.6% ($n = 38$) showed delayed eruption, 8.3% ($n = 14$) showed early eruption, and 69% ($n = 116$) showed normal eruption status in children.

Out of 22 overweight children, 54.5% ($n = 12$) showed delayed eruption, 18.2% ($n = 4$) showed early eruption, and 27.3% ($n = 6$) showed normal eruption status in children.

Furthermore, out of 42 obese children, 38.1% ($n = 16$) showed delayed eruption, 21.4% ($n = 9$) showed early eruption, and finally, 40.5% ($n = 17$) showed normal eruption status in children.

Table 2 shows that there was a significant association between BMI and teeth eruption.

Table 3 represents the relationship between BMI and oral hygiene status in children. OHI-S shows three overall results, namely good, fair, and poor.

Table 1: BMI and its association with DMFT score of the population

BMI	N	Mean DMFT score	Standard deviation
Underweight	68	1.03	1.40
Healthy	168	0.79	1.38
Overweight	22	0.64	1.46
Obese	42	0.55	1.04
Total	300	0.80	1.35

One way Anova test	Sum of squares	df	Mean square	F	P-value
Between groups	6.855	3	2.285	1.245	0.294
Within groups	543.145	296	1.835		
Total	550.000	299			

BMI: Body mass index, DMFT: Decayed, missing, and filled teeth

Table 2: BMI and its association with the teeth eruption status of the population

BMI	Eruption stage			Total
	Early	Normal	Delayed	
Underweight	12 17.6%	32 47.1%	24 35.3%	68 100.0%
Healthy	14 8.3%	116 69.0%	38 22.6%	168 100.0%
Overweight	4 18.2%	6 27.3%	12 54.5%	22 100.0%
Obese	9 21.4%	17 40.5%	16 38.1%	42 100.0%
Total	39 13.0%	171 57.0%	90 30.0%	300 100.0%
Chi-square value	df	P-value		
26.595	6	<0.001		

BMI: Body mass index

A total of 68 underweight children were observed, among which 44.1% ($n = 30$) showed “fair” oral hygiene, 51.5% ($n = 35$) showed “good” oral hygiene, and 4.4% ($n = 3$) showed “poor” oral hygiene.

Out of 168 healthy children, 34.5% ($n = 58$) showed “fair” oral hygiene, 54.8% ($n = 92$) showed “good” oral hygiene, and 10.7% ($n = 18$) showed “poor” oral hygiene.

Out of 22 overweight children, 22.7% ($n = 5$) showed “fair” oral hygiene, 72.7% ($n = 16$) showed “good” oral hygiene, and 4.5% ($n = 1$) showed “poor” oral hygiene.

Out of 42 obese children, 47.6% ($n = 20$) showed “fair” oral hygiene, 40.5% ($n = 17$) showed “good” oral hygiene, and 11.9% ($n = 5$) showed “poor” oral hygiene.

The P -value is more than 0.05, and hence, the results show no significant relationship between BMI and oral hygiene status in children.

DISCUSSION

Physical health has a great impact on the life of an individual. Health has a direct relationship with the systemic efficacy of a child. BMI of a child holds the utmost importance for their physical health and associated factors. This study was done to evaluate the association of BMI with dental caries, tooth eruption status, and oral hygiene of a child. The modern era has changed the lifestyle and dietary patterns of the current population. Increased energy consumption and poor physical activity are the major factors leading to overweight and obesity.

Various scientific studies have compared BMI with dental caries, as both are believed to have common etiological representatives. Kim and Kim (2017)^[1] concluded that dental caries (DMFT ≥ 1) was not significantly related to obesity. However, obesity might be a risk factor for periodontitis (CPI ≥ 3) and Kumar *et al.* (2017)^[2] concluded that there were no differences in caries experience between overweight

Table 3: BMI and its association with oral hygiene status of the population

BMI	OHI-S (Good/Fair/Poor)			Total
	Poor	Fair	Good	
Underweight	3 4.4%	30 44.1%	35 51.5%	68 100.0%
Healthy	18 10.7%	58 34.5%	92 54.8%	168 100.0%
Overweight	1 4.5%	5 22.7%	16 72.7%	22 100.0%
Obese	5 11.9%	20 47.6%	17 40.5%	42 100.0%
Total	27 9.0%	113 37.7%	160 53.3%	300 100.0%
Chi-square value	df	P-value		
9.580	6	0.144		

BMI: Body mass index, OHI-S: simplified oral hygiene index

and normal-weight children from medium (incidence rate ratio [IRR] = 1.10; 95% confidence interval [CI]: 0.60–2.04) and low (IRR = 0.98; 95% CI: 0.49–1.95) SES families that are in agreement with this study. Considering the type of dentition, a study done by Swaminathan *et al.* (2019)^[3] showed that there is no association of BMI with dental caries in children in both deciduous and mixed dentition. While Bulut and Bulut (2020)^[4] found no difference between obesity and caries prevalence in deciduous dentition ($P = 0.957$), a statistically significant association was found in the permanent dentition ($P = 0.002$). There are abundant studies indicating a positive relation between BMI and dental caries. A study conducted by Sharma and Hegde (2009)^[5] found that obese and overweight children have more tendency to prefer sweet and fat-containing snacks than their counterparts, which is in agreement with a study by Elangovan *et al.* (2012).^[6] In case of children with special needs, Ashour *et al.* (2018)^[7] concluded that obese and overweight children were 2.98 times (adjusted odds ratios [ORs] = 2.9; 95% CI = 1.2–4.9) more susceptible to have dental caries compared to the normal and underweight subjects. The increasing adipose tissue leads to changes in hormonal secretion and Metabolism, such as a rise in secretion of insulin-like growth factor-1 and the metabolism of minerals. Such factors may result in the acceleration of tooth eruption.^[8] Hence, there might be a positive relationship between BMI and tooth eruption. Tooth eruption has a wide range for the emergence of each tooth in the oral cavity. The change in eruption timing either early or delayed is not much uncustomary these days, and hence, an attempt was made in this study to find if there is any correlation between BMI and tooth eruption. In pediatric and orthodontic treatment, the relationship between BMI and tooth eruption is an important variable since the time of the treatment is important. Studies by Hilgers *et al.* (2006)^[9] and Sánchez-Pérez *et al.* (2010)^[10] are in agreement with this study which presented that overweight and obese individuals had accelerated dental development ($P < 0.01$) and a lower caries index ($P < 0.01$), respectively.

Must *et al.* (2012)^[11] and Wong *et al.* (2017)^[12] concluded that obese children have earlier emergence and more number of teeth present than non-obese subjects after adjusting for gender, age, race, and ethnicity ($P < 0.0001$) which was highly significant and that the emergence of permanent teeth is significantly associated with obesity ($P < 0.01$), respectively. A longitudinal growth series conducted by Nicholas *et al.* (2018)^[13] reported that children with high BMI are significantly associated with accelerated dental emergence ($P < 0.001$). A study by Dimaisip-Nabuab *et al.* (2018)^[14] demonstrated that underweight and stunted growth children are associated with a delayed eruption of permanent teeth ($P = 0.001$). BMI shares some common factors with dental caries such as diet, frequency of eating, and sugar intake of a child. These factors are indicators of not only dental caries but also of their linkage to the oral hygiene status. The overall energy consumption and expenditure are correlated with the change in the body's systemic and metabolic functions. A study by Franchini *et al.* (2011)^[15] concluded that gingivitis perceived in obese and overweight pediatric patients is probably due to an amalgamation of both inflammatory and metabolic profiles and ignorance toward oral hygiene. Another study by Mathur *et al.* (2011)^[16] reported that obesity could be a possible cause of periodontal disease in all age groups and the prevalence of periodontal disease is remarkably ($P = 0.03$) more in obese (88%) than in non-obese (74.4%) individuals. Friedlander *et al.* (2003)^[17] noted that obese subjects had low psychosocial health, self-esteem, and physical functioning which in turn might also have had an influencing role on oral health. Such insecurities might lead to guilt and body shaming which affects the personality of the child and the behavior toward grooming or cleaning themselves which also includes brushing and flossing ultimately leading to poor oral health.

Sede and Ehizele (2014)^[18] reported that no significant relationship between obesity and periodontal status was found. However, increased BMI may be a predictor of the gingival bleeding index (GBI) ($P = 0.046$, OR = 0.07, 95% CI = 0.010.96). In contrast to this study, a study conducted by Halder *et al.* (2018)^[19] showed a positive association between obesity and oral health status ($P < 0.01$, regression coefficient [b] is 0.028) and concluded that obesity is related to the oral hygiene status of children. On the one hand, Ferraz *et al.* (2014)^[20] concluded that oral hygiene index ($P < 0.001$) and GBI ($P < 0.001$) were significantly higher in the group of obese children while on the other hand, Vallogini *et al.* (2017)^[21] reported that better oral hygiene (VPI) (obese: 25.69 ± 25.83 ; normal-weight: 37.72 ± 24.34 ; $P < 0.001$) and fewer compromised teeth and comparatively better periodontal health sites (PPD ≤ 3) (obese: 101.92 ± 9.27 ; normal-weight: 97.28 ± 12.13 ; $P < 0.001$) were seen in obese adolescents than their normal-weight counterparts.

In today's era, maintaining a healthy body and oral cavity go hand in hand. The human body responds accordingly to what he eats and so does the oral cavity. Food rich in sugar and fat is not only harmful to the body but also adversely affects

the oral cavity. Obese children tend to have a higher amount of cariogenic as well as calorogenic food, which leads to the accumulation of plaque. Excessive plaque deposition, frequent eating, and limited brushing of teeth are responsible for poor oral hygiene, which ultimately creates a favorable environment for oral microorganisms to cause dental caries. Deposition of plaque also leads to calculus formation and affects gingival as well as periodontal health. Hence, it is important to be aware of the dynamic weight and its effect on the oral cavity.

CONCLUSION

This study concluded the following

1. There was no significant relationship between BMI and dental caries
2. There was a statistically significant association of BMI with tooth eruption status in children
3. There was no significant relationship between BMI and oral hygiene status
4. Tooth eruption status was found to be normal in most children in the healthy group
5. Good oral hygiene was also found in most children in the healthy group
6. DMFT value was found to be maximum in the underweight children group.

Summarizing the results of the present study, no significant correlation can be drawn. Hence, further researches are required to assess and establish a more definitive relationship between BMI and the abovementioned parameters.

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