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ORIGINAL ARTICLE

Correlation of body mass index with eruption time of permanent first molars and incisors and caries occurrence: A cross–sectional study in school children in Uttar Pardesh, India

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ABSTRACT

Aims and Objectives: To determine the mean eruption time of permanent first molars and incisors; to compare this with Body Mass Index (BMI); to correlate the caries frequency with BMI. **Materials and Methods:** 100 school children of 'just erupted' teeth of age 5-10 years were obtained from 10 different schools of Modinagar city, Uttar Pradesh. Weight and height of these individuals were measured and the clinical examination of the oral cavity was done to assess the caries frequency and the eruption status of permanent teeth. Pearson correlation coefficient was utilized to find the correlation between BMI, eruption time and caries frequency. **Results:** BMI and eruption time were found to be negatively associated. A strong positive and significant correlation was observed between BMI and (dft + DFT) score for overweight females, while no significant difference was observed in case of males. **Conclusion:** Eruption time of permanent first molars and incisors increases with decrease in BMI values, while caries frequency increases with increase in BMI values.

Key words
Body mass index, caries frequency, eruption time

INTRODUCTION

Tooth eruption is defined as the movement of the tooth from its site of development in alveolar bone to the occlusal plane in the oral cavity. Tooth eruption in the oral cavity occurs over a broad chronological age range and is influenced by various factors like genetics, gender, nutrition, pre-term birth, socioeconomic factors, height and weight, craniofacial morphology, hormonal factors and systemic diseases.[1]

Eruption period of permanent teeth has been studied in different population groups. There are few studies that relate the eruption time, with the weight height and BMI of children. Children who are within the standard range of height and weight show normal eruption time as compared to those who are below the average.[2] Eruption of the teeth is found to be positively related to somatic growth (height and weight) of individuals.[3] Body Mass Index (BMI) is defined as person's weight in kilograms divided by the square of the height in meters.

$$BMI = \frac{\text{Weight (kg)}}{\text{Height (m)}^2}$$

Body mass index can also be correlated with the prevalence of dental caries. Because of the changes in the environment leading to increasing trend of sedentary lifestyle and a high consumption of energy rich food and drinks resulted in conditions like overweight and obesity in children. Overweight and obese individuals are at increased risk of developing various systemic diseases and psychological problems. High sugar intake is reported to be more common among overweight and obese children than those with normal weight and is also recognized as the risk factor for dental caries. Thus, the eating pattern among overweight or obese children may be a risk factor in common for caries and overweight.[4]

Among children and teenagers aged 2-19 years, body fat amount changes as the individual grows and is different

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for boys and girls. Unlike BMI assessments for adults, assessments for children and teenagers take these growth and gender specific differences into account. These children specific BMI values are referred to as "BMI-for age".[5] The four weight categories are:

1. Underweight (BMI for age <5th percentile)
2. Normal (BMI for age 5th-85th percentile)
3. Overweight (BMI for age 86th-95th percentile)
4. Obese (BMI for age >95th percentile).

MATERIALS AND METHODS

Twelve hundred school children, aged 5-10 years, studying in ten different schools of Modinagar city, Uttar Pradesh, were randomly selected and of these individuals only 100 (50 males and 50 females) fulfilled the inclusion criterion of "just erupted tooth". A "just erupted tooth" for the purpose of this study is defined as a tooth which has just emerged and any part of it is visible in the oral cavity on simple visual examination.[2] Written informed consent was obtained from mothers/caretakers of all the study participants, after explaining the purpose and objective of the study.

Weight of the children was measured in kilograms using a standard weighing scale, after removal of shoes [Figure 1]. Height was measured using a calibrated tape with the subject's back and knees completely straight and the feet together [Figures 2 and 3]. Clinical examination of the oral cavity was done using a mouth mirror. The status of eruption of the permanent teeth and caries frequency was noted [Figure 4]. To assess the caries frequency the number of the carious and filled teeth for both permanent dentition (DFT) and primary dentition (dft) were added.

Carious lesions are defined as clinically visible cavities in which an explorer tip can penetrate deep into the soft yielding tooth material suggesting demineralization or undermining caries. In the present study the missing teeth were not counted because the subjects had mixed dentition and hence, it could not be assessed at that time whether the loss of teeth was due to physiological or pathological reasons. Restored teeth with secondary caries were considered as decayed, a tooth restored separately on different surfaces was counted once as a filled tooth.[6] If both deciduous and permanent

Figure 1: Measurement of weight

Figure 2: Measurement of height

Figure 3: Instruments used for measuring height of individuals

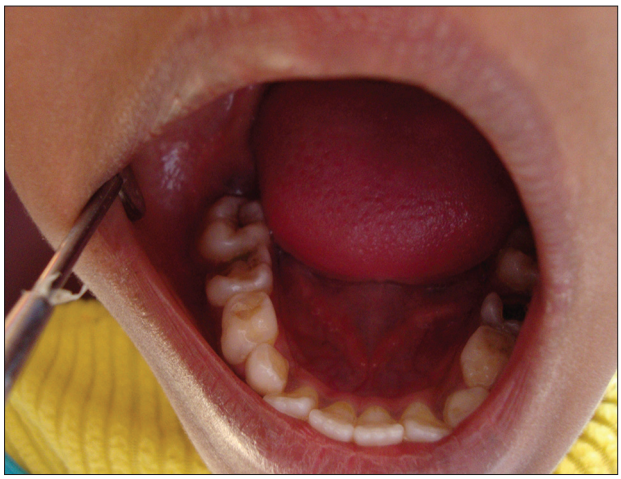

Figure 4: Examination of oral cavity

teeth were present only the permanent teeth were evaluated.[5]

The data were analyzed using Statistical Package for the Social Sciences (SPSS version 19.0). Pearson correlation coefficient was utilized to correlate BMI with eruption time and caries frequency. Furthermore "*t*" test was also used to find any significant difference between males and females for BMI and (dft + DFT) score respectively.

RESULTS

A significant and negative Pearson correlation was observed between BMI and eruption time of 16, 26,36,46,41 teeth in males [Table 1] while no significant correlation was observed between BMI and eruption time in females [Table 2].

All the values of BMI and (dft + DFT) score for different classification in males and females were expressed as Mean ± S.D. respectively. A strong positive and significant correlation was observed between BMI and (dft + DFT) score for over weight in females [Table 3] while no significant correlation was observed in case of males [Table 4]. Unpaired "*t*" test shows no significant difference between males and females for BMI and (dft + DFT) score respectively at α=0.01 level of significance [Tables 5 and 6]. Figures 5 and 6 show mean BMI and (dft + DFT) values for males and females respectively.

DISCUSSION

Variation in tooth eruption is found to be multi-factorial. Dental eruption and skeletal growth are strongly associated with each other. Malnutrition and poor nutrition in early childhood affects tooth eruption and results in delayed emergence of the teeth. Delayed tooth eruption leads to exposure of the teeth in the oral environment for a lesser period of time. This may lead to delay in caries acquisition.[7]

In the present study, a significant negative correlation was observed between BMI and eruption time of molars (16, 26, 36, and 46) and right mandibular central incisor (41) in males. This was in accordance to the study conducted by Nazeer B Khan *et al.*[2] in Saudi male school children but was not in fully accordance with the study of N Khan[3] in Pakistani children in which negative significant correlation was observed between the eruption time and BMI for teeth (26, 41), negative but non-significant correlation for teeth (36 and 46) and significant positive correlation for tooth (16). However, no significant correlation was observed in case of females. More negative correlations than positive indicate an inverse relationship between BMI and eruption time. The mean eruption time of permanent first molars, central and lateral incisors in our study was between 63 to 91 months while Nazeer B Khan *et al.*[2] found the mean age of eruption to be 70.2 to 94.1 m.

Table 1: Correlation of eruption time of permanent first molars and incisors in males with their BMI

Tooth number	Sample size (*n*)	Pearson correlation (r)	*P* value
16	49	−0.4229	0.002
26	48	−0.4195	0.003
36	49	−0.4222	0.002
46	49	−0.4305	0.002
11	30	−0.3992	0.028
21	31	−0.4116	0.021
31	36	−0.3765	0.023
41	37	−0.5117	0.001
12	29	−0.3648	0.051
22	28	−0.3008	0.119
32	29	−0.3262	0.083
42	30	−0.3241	0.08

BMI – Body mass index

Table 2: Correlation of eruption time of first molars and incisors in females with their BMI

Tooth number	Sample size (*n*)	Pearson correlation (r)	*P* value
16	48	0.0863	0.559
26	47	0.0687	0.646
36	47	0.0297	0.842
46	49	−0.0441	0.763
11	35	−0.3971	0.821
21	36	−0.0701	0.684
31	42	−0.1811	0.251
41	39	−0.0883	0.592
12	30	−0.1628	0.390
22	28	−0.1029	0.602
32	36	−0.1358	0.429
42	35	−0.0992	0.570

BMI – Body mass index

Table 3: Karl-Pearson correlation coefficient and its significance for different BMI classification in females

BMI classification	r (BMI and dft+DFT) females	*P* value
Obese	−0.1315	0.1698
Over weight	0.8128	0.0000
Normal weight	−0 0.0330	0.0978
Under weight	−0.1259	0.1887

*P<0.01 shows a significant correlation between BMI and dft+DFT score for overweight at α=0.01 level of significance

Table 4: Karl-Pearson correlation coefficient and its significance for different BMI classification in males

BMI classification	r (BMI and dft+DFT) males	*P* value
Obese	−0.2122	0.1578
Over weight	0	1.234
Normal weight	−0 0.0954	0.0347
Under weight	−0.0483	0.0523

BMI – Body mass index; DFT – Decayed filled teeth

Table 5: Probable values of unpaired "*t*" test between males and females for BMI

BMI classification	Mean±S.D (BMI)		*P* value
	Males	Females	
Obese	23.6±3.1	22.9±1.7	0.4808
Over weight	0±0	19.9±1.4	3.0241
Normal weight	15.1±1.1	15.1±1.4	0.2345
Under weight	13.1±0.7	13.0±0.4	0.5445

**P*>0.01 shows no significant difference between males and females at α=0.01 level of significance, BMI – Body mass index

Table 6: probable values of unpaired "*t*" test between males and females for (dft+DFT) score

BMI classification	Mean±S.D (dft+DFT) score		*P* value
	Males	Females	
Obese	1.923±2.0191	1.7±1.0593	0.7362
Over weight	0±0	1.333±2.3094	1.3554
Normal weight	1.2083±2.1054	1.222±1.2195	0.9775
Under weight	1.1538±1.7246	1.1±1.8081	0.6610

**P*>0.01 shows no significant difference between males and females at α=0.01 level of significance

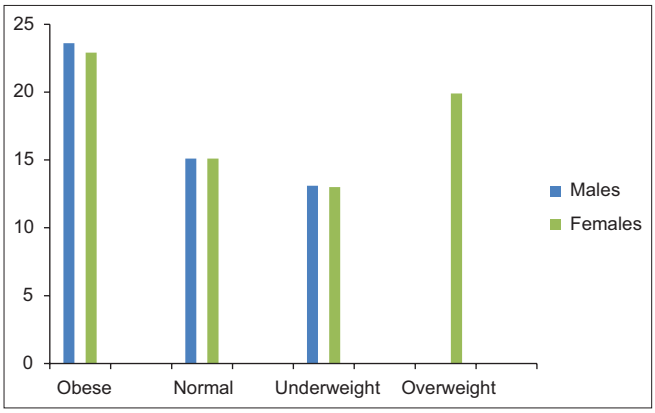

Figure 5: Mean BMI values for males and females

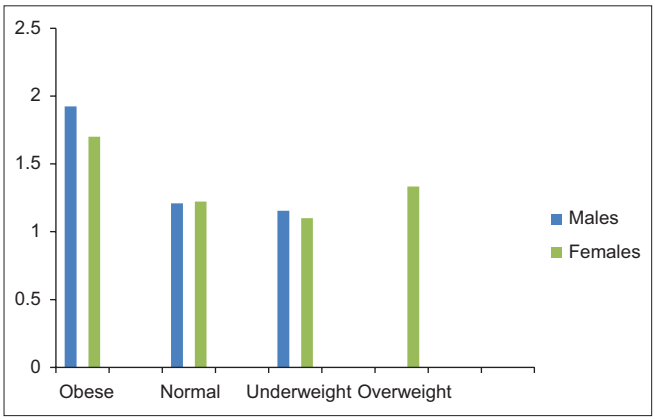

Figure 6: Mean (dft+DFT) values for males and females

Eruption of permanent teeth may be delayed in children who suffered from malnutrition during infancy. Chronic malnutrition delays primary dentition and later exfoliation. With delay in exfoliation of primary teeth, the permanent dentition will be affected. When the first permanent teeth appear late in the oral cavity, the time required for the completion of secondary dentition is longer. Individuals that are malnourished will have low BMI values and will show delayed eruption of permanent teeth.

Common etiological factors for both obesity and caries include negative changes in eating, increased frequency of snacking, and increased consumption of fermentable carbohydrates.[8]

Both obesity and dental caries are related to dietary habits in children. In the earlier study conducted by Sreebny LM[9] a significant relationship between increased sugar intake and dental caries has been established.

Consumption of soft drinks is also associated with increased calorie intake, increased body weight, pediatric obesity and dental caries.

The result of this study showed that increased BMI is linked to a higher prevalence of dental caries which is in agreement with some earlier studies. Ludwig *et al.*[10] concluded that the increasing prevalence of obesity in children was linked to the consumption of sugar sweetened drinks, so frequent consumption of sugar containing products may result in an increased number of cariogenic microorganisms. Barkeling *et al.*[11] showed that the mutans streptococcus count was correlated to BMI and to higher intake of sweet food. Modeer *et al.*[12] found that obese individuals exhibit a lower flow rate of stimulated whole saliva compared with normal weight individuals that could be another reason for increased BMI linked to a higher prevalence of dental caries.

A study conducted by Brita Willerhausen *et al.*[13] showed significant correlation between high weight and caries frequency in the first dentition and in the permanent dentition. However Gerdin EW *et al.*[14] in 2303 Swedish children found a weak association between overweight and dental caries.

The mean (dft + DFT) values in weight classes increased from the underweight children to those with normal weight or overweight up to those suffering from obesity in our study, which was in accordance to the study conducted by B Willershausen[15] that showed a significant correlation between BMI and caries frequency. The possible reasons for such findings in our study include individuals with increased BMI values show early eruption of teeth and for any given age teeth that emerged earlier were exposed to oral cavity environment for greater period of time thus increasing the prevalence of caries in those individuals and also children with increased BMI generally had increased frequency of snacking and take increased amount of fermentable carbohydrates leading to increased caries prevalence.

A strong positive and significant correlation was observed between BMI and (dft + DFT) score for over weight in females only which depicts BMI to be directly related to (dft + DFT) score.

CONCLUSION

Eruption time increases with decrease in BMI value, while (dft + DFT) score increases with increase in BMI value.

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