ORIGINAL ARTICLE

Association between Mean Age of Eruption of the Permanent Teeth and Body Mass Index among School-going Children of 7–17 Years of Age in Chennai City

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Abstract

Aim: The aim of this study was to determine the association between mean age of eruption of the permanent teeth and body mass index (BMI) among 7–17-years-old school-going children in Chennai city.

Materials and methods: This cross-sectional study was conducted among 400 school-going children of age 7–17 years. It was carried out by a single examiner and an average of 50 children was examined per day. Clinical examination was done to assess the eruption status of the permanent teeth which was categorized according to the criteria given by Pahkala et al.[1] Individual height and weight were noted and further BMI was calculated.

Results: A total of 196 (49.1%) boys and 204 (50.9%) girls were assessed. Among the 400 children assessed, 19 (4.75%) were underweight, 321 (80.25%) belonged to normal category, 41 (10.25%) were at the risk of overweight, and 19 (4.75%) were obese. Overall, female children were found to have earlier eruption of the permanent teeth compared to males. Also, it was found that the mean age of eruption increased with increasing BMI indicating delayed eruption in obese children.

Conclusion: The present study shows a significant association between BMI and mean age of eruption of the permanent teeth among school-going children of 7–17 years of age in Chennai city. Further longitudinal multicentric studies are recommended to determine the exact relationship between BMI and dental development.

Keywords: Body mass index, Children, Eruption, Permanent teeth.

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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.[2] Tooth eruption in the oral cavity occurs over a broad chronological age range and is influenced by various factors such as genetics, gender, nutrition, preterm birth, socioeconomic factors, height and weight, craniofacial morphology, hormonal factors, and systemic diseases.[2,3] Studies have also reported differences in the eruption of the permanent teeth between ethnic groups, nutritional factors, and congenital abnormalities such as supernumerary teeth, Down's syndrome, cleidocranial dysplasia, and environmental trends.[4–7]

Eruption of the teeth is found to be positively related to somatic growth (height and weight) of individual. Of all the factors that influence tooth eruption, nutrition is believed to play a positive role in accelerating the process. Many authors across the globe have also reported that poor nutrition during the growing period will in turn have adverse influence on the dental development including delay in the eruption of both deciduous and permanent teeth, congenital dental anomalies, and poor oral health.[5–10]

Body mass index has been one of the most common indicators to determine and compare somatic growth among large group of people, especially children. Also, it is one of the most common and simplest methods to assess the nutrition status of an individual. body mass index, usually measured as Quetelet index, is defined as person's weight in kilograms divided by the square of the height in meters.[3,4] It is usually calculated using the formula:

$$\text{BMI} = \frac{\text{weight (kg)}}{\text{height m}^2}$$

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Unlike BMI assessments for adults, assessments for children and teenagers take the growth- and gender-specific differences into account. Among children, specific BMI values are referred to as "BMI for age," as given by the Centers for Disease Control and Prevention (CDC).[4,5] Literature evidence show that children with lesser height and weight for their age have delayed the eruption of teeth than their normal counterparts.

Hilgers et al. studied the relationship between obesity and dental development in 104 children and showed that dental development significantly accelerates with increase in BMI.[11] A 4-year longitudinal study on 110 Mexican elementary school children concluded that overweight children had more erupted teeth with lesser incidence of caries than children with lower BMI.[12] Sadeghianrizi studied the relationship between craniofacial development and obesity using lateral cephalometrics and

reported that the rate of growth, development, and the length of craniofacial structures were more in obese individuals compared to children with normal BMI.[13]

With these variations in relationship between BMI, mean age of eruption, and barely few evidence reporting these variations among the Indian children, the present study was aimed to determine the association between mean age of eruption of the permanent teeth and BMI, among school-going children of 7–17 years of age, in Chennai city.

Materials and Methods

Prior approval was obtained from the heads of the schools of all the study participants, after explaining the aims, objectives, and methodology of the study. Ethical clearance was obtained from the institutional review board of Ragas Dental College and Hospital, Chennai. A total of 3,539 children were screened in 5 private schools in Chennai city. Among these, four hundred school-children, between 7 and 17 years of age who gave informed consent to participate, were only included in the study. The date of birth of the children was confirmed from the school records.

Height of the children was measured using a calibrated tape attached to a wall, with the subjects back and knees straight, and feet together. Weight was calculated for each child using a digital weighing machine. With the obtained values of height and weight, body mass index was calculated for all children with the formula given by Ancel Keys.[3] Based on individual BMI values, the children were divided into four groups using the criteria given by the Centers for Disease Control and Prevention (CDC),[5] which was as follows:

- Underweight (BMI for age <5th percentile)
- Normal (BMI for age 5th–85th percentile)
- Overweight (BMI for age 85th–95th percentile)
- Obese (BMI for age >95th percentile)

Each tooth was also examined for their clinical stage of eruption in the oral cavity and noted according to the criteria given by Pahkala et al.[1] as:

- Stage 0—the teeth is not visible in the oral cavity.
- Stage 1—at least one cusp is visible in the oral cavity.
- Stage 2—the entire occlusal surface visible but not reached the occlusal level.
- Stage 3—the tooth in occlusion or at the level of the occlusal plane if the antagonistic tooth was not fully erupted.

For the purpose of analysis, the stages of eruption were dichotomized, i.e., teeth which were noted stage 0, 1 were considered to be unerupted and teeth which were noted stage 2, 3 were considered to be erupted.

The data collected were entered in Microsoft Xcel 2003–2007 and the analysis was done using SPSS v.20 software (Chicago, USA). Normality was assessed using graphical method and confirmed using Kolmogrov–Smirnov test. The comparison between the mean age of eruption of the permanent teeth in girls and boys was done using *t* test. Comparison of BMI and age of eruption of the permanent teeth was done using ANOVA.

Results

A total of 196 (49.1%) boys and 204 (50.9%) girls were assessed. The mean age of the children was found to be 10.17 ± 2.37 years. Among the 400 children assessed, 19 (4.75%) were underweight, 321 (80.25%) belonged to normal category, 41 (10.25%) were at the risk of overweight, and 19 (4.75%) were obese.

The mean age of eruption of all the permanent teeth excluding the third molar among both males and females is given in Table 1. It was found that there is a significant difference in the eruption pattern of all the permanent teeth between both the genders. In this study population, all permanent teeth in the maxillary and mandibular arch erupted earlier in females than in males.

When compared to underweight children, overweight children were found to show delayed eruption of teeth. This delayed eruption was noticed in the maxillary first molar, maxillary first premolar, maxillary canine, and maxillary incisors. In the lower arch, delayed eruption was noticed in the mandibular first molar, mandibular premolars, mandibular canines, and mandibular incisors. Tables 2 and 3 show the comparison between various groups of BMI and the mean age of eruption of the maxillary and mandibular permanent teeth, respectively.

Discussion

Body mass index has been used for assessing the anthropometric characteristics in both children and adults. Even though it is an

Table 1: Mean age of eruption of teeth among males and females*

Teeth	*Mean age, males (years)*	*Mean age, females (years)*
UR second molar	13.98 ± 1.00	11.42 ± 0.88
UR first molar	11.07 ± 2.87	9.34 ± 1.27
UR second premolar	13.93 ± 1.10	10.68 ± 0.89
UR first premolar	13.82 ± 1.31	10.33 ± 0.91
UR canine	13.64 ± 1.48	10.16 ± 1.06
UR lateral incisor	12.45 ± 2.44	9.75 ± 1.11
UR central incisor	11.28 ± 2.86	9.42 ± 1.25
UL central incisor	11.26 ± 2.93	9.42 ± 1.26
UL lateral incisor	11.90 ± 2.93	9.69 ± 1.16
UL canine	13.67 ± 1.46	10.16 ± 0.99
UL first premolar	13.77 ± 1.42	10.40 ± 0.89
UL second premolar	13.84 ± 1.26	10.69 ± 1.02
UL first molar	11.12 ± 2.87	9.35 ± 1.27
UL second molar	13.91 ± 1.16	11.66 ± 0.68
LL second molar	13.91 ± 1.12	11.12 ± 0.83
LL first molar	11.15 ± 2.87	9.38 ± 1.26
LL second premolar	13.87 ± 1.17	10.74 ± 0.85
LL first premolar	13.81 ± 1.23	10.51 ± 0.89
LL canine	13.61 ± 1.64	10.21 ± 0.98
LL lateral incisor	11.68 ± 2.79	9.51 ± 1.22
LL central incisor	11.09 ± 2.88	9.36 ± 1.27
LR central incisor	11.05 ± 2.87	9.36 ± 1.27
LR lateral incisor	11.59 ± 2.80	9.50 ± 1.23
LR canine	13.63 ± 1.56	10.25 ± 0.96
LR first premolar	13.81 ± 1.22	10.52 ± 0.93
LR second premolar	13.89 ± 1.14	10.82 ± 0.82
LR first molar	11.04 ± 2.88	9.34 ± 1.27
LR second molar	13.87 ± 1.24	10.90 ± 1.06

*p value of 0.001 was found between mean age of eruption of the permanent teeth between male and female which is significant ($p \leq 0.05$); UR, upper right; UL, upper left; LR, lower right; LL, lower left

Table 2: Comparison of mean age of eruption (vs) BMI: maxillary teeth*

BMI_final	*UR first molar*	*UR first pre molar*	*UR canine*	*UR lateral incisor*	*UR central incisor*	*UL central incisor*	*UL lateral incisor*	*UL canine*	*UL first pre molar*	*UL first molar*
Underweight	9.86 ± 2.21	11.44 ± 2.06	11.27 ± 2.20	10.83 ± 2.15	10.08 ± 2.18	9.67 ± 2.93	10.69 ± 2.12	11.27 ± 2.20	12.07 ± 1.90	9.86 ± 2.21
Normal	9.91 ± 2.31	12.08 ± 2.07	11.98 ± 2.14	10.73 ± 2.22	10.04 ± 2.24	10.06 ± 2.25	10.49 ± 2.40	12.10 ± 2.12	12.25 ± 2.07	9.93 ± 2.23
At risk of overweight	11.42 ± 2.50	12.66 ± 1.99	12.78 ± 2.07	11.98 ± 2.13	11.46 ± 2.52	11.46 ± 2.52	11.63 ± 2.47	12.57 ± 2.15	12.82 ± 1.99	11.42 ± 2.50
Obese	12.71 ± 2.42	13.78 ± 1.70	14.25 ± 1.21	12.91 ± 2.31	12.71 ± 2.42	12.71 ± 2.42	12.91 ± 2.31	14.00 ± 1.56	13.78 ± 1.70	12.71 ± 2.42
Total	10.19 ± 2.31	12.28 ± 1.81	12.23 ± 2.16	11.02 ± 2.29	10.32 ± 2.37	10.32 ± 2.42	10.78 ± 2.47	12.29 ± 2.15	12.46 ± 2.06	10.21 ± 2.37
p value	0.001	0.013	0.001	0.001	0.001	0.001	0.001	0.009	0.04	0.001

**p* value ≤0.05 indicating significance; UR, upper right; UL, upper left

Table 3: Comparison of mean age of eruption vs BMI: mandibular teeth*

BMI_final	*LL first molar*	*LL first pre molar*	*LL canine*	*LL lateral incisor*	*LL central incisor*	*LR central incisor*	*LR lateral incisor*	*LR canine*	*LR first pre molar*	*LR second pre molar*	*LR first molar*
Underw eight	9.86 ± 2.21	11.7 8 ± 2.21	11.20 ± 2.09	10.36 ± 2.16	9.86 ± 2.21	9.86 ± 2.21	10.25 ± 2.14	11.27 ± 2.20	11.78 ± 2.21	14.00 ± 0.86	9.86 ± 2.21
Normal	9.96 ± 2.22	12.51 ± 1.89	11.85 ± 2.16	10.21 ± 2.25	9.93 ± 2.24	9.92 ± 2.24	10.20 ± 2.25	11.86 ± 2.10	12.50 ± 1.90	12.94 ± 1.69	9.88 ± 2.22
At risk of overwei ght	11.42 ± 2.50	12.72 ± 2.00	12.58 ± 2.10	11.70 ± 2.38	11.42 ± 2.50	11.42 ± 2.50	11.66 ± 2.44	12.68 ± 2.06	12.87 ± 1.96	13.52 ±1.65	11.50 ± 2.48
Obese	12.71 ± 2.42	14.29 ± 1.21	14.00 ± 1.56	13.14 ± 2.16	12.71 ± 2.42	12.71 ± 2.42	12.91 ± 2.31	13.78 ± 1.70	14.29 ± 1.21	14.29 ± 1.21	12.71 ± 2.42
Total	10.24 ± 2.36	12.66 ± 1.93	12.08 ± 2.18	10.53 ± 2.57	10.21 ± 2.38	10.20 ± 2.37	10.50 ± 2.37	12.10 ± 2.14	12.68 ± 1.93	13.21 ± 1.67	10.17 ± 2.37
p value	0.001	0.01	0.002	0.001	0.001	0.00	0.001	0.003	0.011	0.037	0.001

**p* value ≤0.05 indicating significance; LR, lower right; LL, lower left

indicator of body fatness among children, it has been a predominant measure of nutrition status, especially with the Centre for Disease Control (CDC) reporting separate age-specific growth charts for boys and girls.[3,5] Availability and accessibility to the right food at the right time is important for the overall growth and development of children.[7,8] Tooth eruption also forms an important milestone in this development which is influenced by a variety of factors such as gender, nutrition, preterm birth, genetics, height and weight, hormonal factors, and systemic diseases.[2,8,10]

In our present study on comparing the mean ages of eruption of the permanent teeth, female children showed an overall earlier eruption compared to their male counterparts. This was concurrent with the existing evidence among the Indian population, as reported by Lakshmappa et al. and Gaur et al.[14,15] Similar results have also been reported internationally by Pahkala et al., Diamanti et al., and Hernández et al.[1,16,17] However, Bagewadi et al. reported early eruption of few permanent teeth such as the maxillary canine, mandibular second premolar, maxillary and mandibular second molar among male children.[18] On an average, the difference in time period of eruption between male and female children in our study was between 2 and 2.5 years between males and females, which was earlier believed to be around 4–6 months.[10] The main reason for this gender difference in the age of eruption can be attributed to hormonal changes which usually occur earlier in females with a catch-up development seen in male children in their late adolescence. Also, there could be differences due to race, ethnicity, genetic, socioeconomic status, and nutrition pattern which vary across the different regions of the globe.[10,19–21]

The sequel or order of eruption seen in both maxilla and mandibular arches of both males and females showed similar patterns. In the maxillary arch, it was the first molars followed by central incisors, lateral incisors, canines, first premolars, second premolars, and second molars. In the mandibular arch, it is first the central incisors followed by mandibular first molars, lateral incisors, canines, first premolars, second premolars, and second molars. Almoniatiene et al. claimed a frequency of 20% variation in the upper arch, 17% in the lower arch for males, and 12% (upper arch) and 8% (lower arch) for females.[10] He suggested that the change in eruption sequence is clinically seen as an eruption of maxillary canine before the second premolar in girls, and the mandibular second premolar before second molar in boys, which was typically seen in our present study.

However, on comparing the eruption pattern between maxillary and mandibular arches, eruption in the mandibular arch always preceded the maxillary arch. Similar studies among Indian school-going children by Bagewadi et al., Gaur et al., and Lakshmappa et al. have also reported the same results. This was also in consistence with similar studies done in children belonging to different race by Pahkala et al., Diamanti and Townsend, Hernández et al., and Khan.[1,14–18,22]

Finally, on comparing the mean age of eruption with the BMI, all the teeth, except maxillary second premolars, mandibular right second premolar and all second molars in both the arches showed a significant association. However, the mean age of eruption significantly increased with increasing BMI indicating delayed eruption among obese children and children who are at the risk of overweight. This was conflicting to the existing knowledge that there exists a positive correlation between childhood obesity and the age of eruption of the permanent teeth.[23–25] Unequal distribution of children among different BMI groups in the present study population could be a possible explanation for the observed variations. Childhood obesity is believed to accelerate dental development by an average of 6–12 months.[21,23] However, these results cannot be extrapolated as one study by Anbiaee et al.[21] used panoramic imaging for assessing eruption, while a study by Parner et al.[23] established the variation in the trend of eruption of the permanent teeth specifically for the Danish children.

Conclusion

The present study showed a significant association between BMI and the mean age of eruption of the permanent teeth among school-going children of 7–17 years of age in Chennai city. On comparing the eruption of permanent teeth in both the genders, females showed an overall earlier eruption than boys. Further, children who were overweight were found to have a delay in the eruption of the permanent teeth than children with a lower BMI. Hence, in future, longitudinal multicentric studies are recommended to determine the trends in the eruption of the permanent teeth among Indian population.

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