Journal of Dental Applications

Open Access

Austin Publishing Group

Research Article

Association between Body Mass Index (BMI) and Mean Age of Eruption of Permanent Teeth among School Going Children of 7-17 Years of Age in Chennai City

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Received: January 15, 2018; **Accepted:** February 19, 2018; **Published:** March 01, 2018

Abstract

Aim: The aim of this study was to determine the association between mean age of eruption of permanent teeth and Body Mass Index (BMI) among 7- 17 year old school going children in Chennai city.

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 averages of 50 children were examined per day. Clinical examination was done to assess the eruption status of permanent teeth which was categorized according to the criteria given by Phakala et al (1991). Individual height and weight were noted and further BMI was calculated.

Results: A total of 196 (49.1%) boys and 204 (n=50.9%) girls were assessed. Among the 400 children assessed 19 (4.8%) were underweight, 321 (80.5%) belonged to normal category, 40 (10%) were at the risk of overweight and 19 (4.8%) were obese. Overall female children were found to have earlier eruption of permanent teeth compared to males. Also, it was found that mean age of eruption increased with increasing BMI indicating delayed eruption in obese children.

Conclusion: The present study shows a significant association between Body Mass Index (BMI), mean age of eruption of 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; Eruption; Permanent teeth; Children

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 [1]. Tooth eruption in the oral cavity occurs over a broad chronological age range and is influenced by various factors like genetics, gender, nutrition, preterm birth, socioeconomic factors, height and weight, craniofacial morphology, hormonal factors and systemic diseases [1,2]. Studies have also reported differences in the eruption of permanent teeth between ethnic groups, nutritional factors, and congenital abnormalities such as supernumerary teeth, Down's syndrome, cleidocranial dysplasia and environmental trends [3-6].

Eruption of the teeth is found to be positively related to somatic growth (height and weight) of individual. Also 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 eruption of both deciduous and permanent teeth, congenital dental anomalies, and poor oral health [4-9].

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 (BMI), usually measured as Quetelet index is defined as person's weight in kilograms divided by the square of the height in meters [2,3]. It is usually calculated using the formula: BMI= (weight(kg))/(height (m)^2)

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) [3,4]. Literature evidence shows that children with lesser height and weight for their age have delayed eruption of teeth than their normal counterparts.

Hilgers and coworkers studied the relationship between obesity and dental development in 104 children and showed that dental development significantly accelerates with increase in body mass index [10,11]. Sadeghianrizi studied the relationship between craniofacial development and obesity using lateral cephalometrics and reported that the rate of growth, development and length of craniofacial structures was more in obese individuals compared to children with normal BMI [12]. With these variations in relationship

Citation: Anusha R, Nagarajan S, Afraa Sultan S, Natrajan S, Muniyappan G and Madan kumar PD. Association between Body Mass Index (BMI) and Mean Age of Eruption of Permanent Teeth among School Going Children of 7-17 Years of Age in Chennai City. J Dent App. 2018; 5(1): 407-410.

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 permanent teeth and Body Mass Index (BMI), among school going children of 7-17 years of age, in Chennai city.

Materials and Methods

Prior approval was obtained from heads of the schools of all the study participants, after explaining the aims, objectives and methodology of the study. Ethical clearance was obtained from 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 7-17 years of age who gave informed consent to participate was only included in 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 [2]. 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) [4], which was as follows:

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

Each tooth was also examined for their clinical stage of eruption in oral cavity and noted according to the criteria given by Phakala et al (1991) [13] 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, that is, teeth which were noted stage 0,1 were considered to be un-erupted and teeth which were noted stage 2, 3 were considered to be erupted.

The data collected were entered in Microsoft Xcel 2003-2007 and 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 permanent teeth in girls and boys was done using *t*-test. Comparison of BMI and age of eruption of permanent teeth was done using ANOVA.

Results

A total of 196 (49.1%) boys and 204 (n=50.9%) girls were assessed. The mean age of the children were found to be 10.17±2.37 years. Among the 400 children assessed 19 (4.8%) were underweight, 321 (80.5%) belonged to normal category, 40 (10%) were at the risk of overweight and 19 (4.8%) were obese. The mean age of eruption of all the permanent teeth excluding 3rd molar among both males, females are given in Table 1. It was found that there is 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.

Table 1: Mean Age of Eruption of Teeth among Males & Females.

TEETH	Mean age males (years)	Mean age female (years)
UR 2nd molar	13.98±1.00	11.42±0.88
UR 1st molar	11.07±2.87	9.34±1.27
UR 2nd premolar	13.93±1.10	10.68±0.89
UR 1st 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 1st premolar	13.77±1.42	10.40±0.89
UL 2nd premolar	13.84±1.26	10.69±1.02
UL 1st molar	11.12±2.87	9.35±1.27
UL 2nd molar	13.91±1.16	11.66±0.68
LL 2nd molar	13.91±1.12	11.12±0.83
LL 1st molar	11.15±2.87	9.38±1.26
LL 2nd premolar	13.87±1.17	10.74±0.85
LL 1st 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 1st premolar	13.81±1.22	10.52±0.93
LR 2nd premolar	13.89±1.14	10.82±0.82
LR 1st molar	11.04±2.88	9.34±1.27
LR 2nd molar	13.87±1.24	10.90±1.06

*p value of 0.001 was found between mean age of eruption of 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.

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

Table 2a: Comparison Of Mean Age Of Eruption (Vs) BMI: Maxillary Teeth.

BMI_final	UR 1st Molar	UR 1st Premolar	UR Canine	UR Lateral Incisor	UR Central Incisor	UL Central Incisor	UL Lateral Incisor	UL Canine	UL 1st Premolar	UL 1st 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 2b: Comparison Mean Age of Eruption Vs. BMI: Mandibular Teeth.

BMI_final	LL 1st Molar	LL 1st Pre Molar	LL Canine	LL Lateral Incisor	LL Central Incisor	LR Central Incisor	LR Lateral Incisor	LR Canine	LR 1st Pre Molar	LR 2nd Pre Molar	LR 1st Molar
Underweight	9.86±2.21	11.78±2.21	11.20±2.09	10.36±2.16	9.86±2.21	9.86±2.21	10.25±2.14	11.27±2.2	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±2.1	12.50±1.9	12.94±1.69	9.88±2.22
At risk of overweight	11.42±2.5	12.72±2	12.58±2.1	11.70±2.38	11.42±2.5	11.42±2.5	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±1.7	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	0.001	0.003	0.011	0.037	0.001

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

respectively.

Discussion

In our present study, on comparing the mean ages of eruption of 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 A et al (2011) and Gaur R et al (2011) [14,15]. Similar results have also been reported internationally by Phakala et al (1991), Diamenti et al (2003) and Hernandez et al (2008) [13,16,17]. However, Bagewadi NB et al (2016) reported early eruption of few permanent teeth like the maxillary canine, mandibular 2nd premolar, maxillary and mandibular 2nd 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 to 2.5 years between males and females, which was earlier believed to be around 4 to 6 months [9]. The main reason for this gender difference in 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, socio economic status and nutrition pattern which vary across the different regions of the globe [9,19-21].

The sequel or order of eruption seen in both maxilla and mandibular arches of both males and females showed similar patterns. In maxillary arch, it was the first molars followed by central incisors, lateral incisors, canines, first premolars, 2nd premolars and 2nd molars. In the mandibular arch it is first the central incisors followed by mandibular 1st molars, lateral incisors, canines, 1st premolars, 2nd premolars and 2nd molars. Almoniatiene R et al (2010) claimed a frequency of 20% variation in upper arch, 17% in the lower arch for males and 12% (upper arch) and 8% (lower arch) for females [9]. He suggested that, change in eruption sequence is clinically seen as 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 NB et al (2016), Gaur et al (2011) and Lakshmappa et al (2011) have also reported the same results. This was also in consistence with similar studies done in children belonging to different race by Phakala R et al (1991), Diamenti (2003), Hernández M (2008), Khan N (2011) [13-18,22].

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 at the risk of overweight. This was conflicting to the existing knowledge that there exists a positive correlation between childhood obesity and age of eruption of 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 to 12 months [21,23]. However, their results cannot be extrapolated as they have been carried out on different population.

Conclusion

The present study showed a significant association between Body Mass Index (BMI), mean age of eruption of 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, girls showed an overall earlier eruption than boys. Further, children who were overweight were found to have a delay in eruption of permanent teeth than children with a lower BMI. Hence, in future, longitudinal

multicentric studies are recommended to determine the trends in the eruption of permanent teeth among Indian population.

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J Dent App - Volume 5 Issue 1 - 2018
ISSN : 2381-9049 | www.austinpublishinggroup.com

Citation: Anusha R, Nagarajan S, Afraa Sultan S, Natrajan S, Muniyappan G and Madan kumar PD. Association between Body Mass Index (BMI) and Mean Age of Eruption of Permanent Teeth among School Going Children of 7-17 Years of Age in Chennai City. J Dent App. 2018; 5(1): 407-410.