Original article

ASSOCIATION BETWEEN OBESITY AND PERMANENT TOOTH ERUPTION

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ABSTRACT

Purpose: Obesity is a significant health risk of modern society, which prevalence has dramatically increased and affects children at a lower and lower age. The aim of the study is to investigate the effect of obesity on permanent tooth eruption timing.

Material/Methods: A cross-sectional study was performed in Plovdiv, October-December 2017 and January-March 2018, among 1826 school children aged 6-11. Dental examination was executed in the schools' medical rooms, using sterile dental kit and flashlight. The number of erupted permanent teeth (NET) was evaluated considering all in the process of eruption and fully erupted permanent teeth. Data for BMI was collected, and statistical analysis was done. Descriptive statistics, ANOVA, single and multiple linear regression and Chi-square test of independence were used to test the Null hypothesis.

Results: The underweight children were 8.3%, normal weight – 65.8%, overweight 15.6% and 10.3% were obese. There was no significant correlation between gender, age and BMI: $x^2(3) = 4.862$, $p>0.05$; $x^2(18) = 12.451$ $p>0.05$, N=1826. Simple linear regression showed statistical significance of the model, F=166,318p<0.0001, and positive correlation between BMI and NET, B=0,441 where 1% ($R^2=0,084$) of the variation in the NET was explained by BMI. A multiple linear regression, where age and gender were included as explanatory variables, showed that all factors were significantly associated with NET (BMI: B= 0.213; Age: B= 2.662; Gender: B=1.011 p<0.0001).

Conclusions: Increased BMI and being female is associated with accelerated permanent tooth eruption.

Keywords: Children, obesity, permanent tooth eruption,

INTRODUCTION

Obesity, one of the most significant health risk of modern society, is now recognized as a chronic disease with multifactorial etiology. The prevalence of obesity has dramatically increased in recent years all over the world, reaching epidemic levels. This is especially alarming as these proportions are affecting children and adolescence at lower and lower age.

Overweight is defined as a disease in which the energy intake with the food exceeds the body requirements, resulting in body fat accumulation [1]. The anthropometric measurement that is commonly used for diagnosis is the Body Mass Index (BMI). Center of disease control and prevention classifies children with BMI between 85 and 95 percentile specific for age and gender as overweight and those with BMI above 95 as obese [2].

The prevalence of overweight and obesity has doubled over the past 20 years. According to the World Health Organization for European region, every 3rd child is overweight or obese [3]. In Bulgaria, according to the latest National Representative Study on the prevalence of obesity among 7-year-old-school children, conducted during 2015/2016 academic year, 15.4% of boys and 11.4% of girls are obese [4], which shows slight decrease in comparison with previous years, but still ranks Bulgaria fourth in Europe regarding childhood obesity.

Overweight and obesity are multifactorial diseases. Common risk factors are known to be genetic, including the thrifty gene hypothesis [5], but according to the researchers even more important are the behavioral risk factors - dietary habits and consumption of 'fast food', snacks and soft drinks [6]. This in relation with sedentary lifestyle and a long time spent on watching TV, playing computer games and lack of sports and physical activity, contributes to the uprising amount of overweight and obese children in the modern societies.

Complications of obesity are poor self-esteem, decreased life duration, higher risk for diabetes mellitus type 2, cardiovascular diseases, asthma, arthritis, high cholesterol, high blood pressure. Obese children and adolescents are more likely to become obese adults [7]. As a growth-promoting process, obesity has been shown to affect the timing of puberty in boys and girls [8]. Obese children also showed earlier age at peak height velocity compared to nonobese [9].

Tooth eruption is defined as the movement of the tooth from its site of development in the alveolar bone to the occlusal plane in the oral cavity [10]. Permanent tooth emergence is a complex process that can be influenced by a number of general and local factors. Race, gender, genetic, socioeconomic, hormonal factors and systemic diseased are widely described in the literature to have an impact on tooth eruption. As it is proposed that obesity is associated with earlier maturation [11], it is expected that increased BMI will also have an influence on tooth eruption. There is un evidence that nutrition can also correlate with tooth eruption timing, as chronic malnutrition can cause delayed eruption [12]. This plausible association between increased body weight and eruption timing isn't examined in Bulgaria, and the data in the foreign literature is scarce, which motivated the current study. The objective of the paper is to present the effect of obesity on permanent tooth eruption timing among Bulgarian school children.

MATERIALS AND METHODS:

A cross-sectional study was performed in October-December 2017 and January-March 2018 in Plovdiv. The schools participating in the study were randomly selected from all Public schools in Plovdiv by random cluster sampling. 1826 children aged 6-11 were examined by 5 calibrated specialists of Pediatric dentistry. This was performed in the school's medical rooms using sterile dental kit and flashlight. Prior to the oral exam, informed consent was given to the parents of the children and those who didn't return signed paper were excluded from the examination. The number of erupted permanent teeth (NET) was evaluated considering all in the process of eruption and fully erupted permanent teeth. Data for BMI of the examined children was obtained from the medical documentation of the participants from the mandatory annual preventive examinations, performed by the general practitioners. Children were classified into underweight, normal weight, overweight and obese in accordance with WHO criteria 2007 for assessment of body weight among children aged 5-19 years [13].

Statistical methods

All collected data were analyzed using the statistic software package SPSS 17. Descriptive statistics, chi-square test of independence and single and multiple linear regression were used to check the null hypothesis that obesity was not associated with accelerated permanent tooth eruption. A value of $p<0.05$ was considered statistically significant.

RESULTS

One thousand eight hundred and twenty-six school children participated in our study, similarly distributed in gender (table 1).

Table 1. Gender-wise sample distribution

Gender	Frequency	Ratio
Male	953	50.9%
Female	921	49.1%

With regard to BMI, 8.3% of all children were identified as underweight, 65% as normal weight, 15.6% as overweight and 10.3% as obese. In the group of males and females, these proportions were found similar(table 2).

Table 2. Distribution of females and males based on their BMI

Gender	Underweight	Normal weight	Overweight	Obese
Female	79 (8.8%)	589 (65.4%)	151 (16.8%)	82 (9.1%)
Male	74 (7.9%)	623 (66.5%)	133 (14.2%)	107 (11.4%)

There was no significant correlation between gender, age and BMI: $x^2(3) =4.862$, $p>0.05$; $x^2(18) =12.451$ $p>0.05$, N=1826.

Mean, median, mode and standard deviation of Age, BMI, NET in the whole studied population is given in Table 3.

Table 3. Mean, median and Std. Deviation of Age, BMI, and NET

	Age	*BMI*	*NET*
N Valid	1838	1838	1827
Mean	8,49	17.15	13.26
Median	8,50	16.50	12.00
Std. Deviation	1,17	3,14	4,80

Simple linear regression showed statistical significance of the model, F=166,318p<0.0001, and positive correlation between BMI and NET, B=0,441 where 1% (R^2=0,084)of the variation in the NET was explained by BMI.

In order to evaluate the effect of the combination of factors upon NET, multiple regression analysis was performed. BMI, age and gender were set as explanatory variables, and NET - as the response variable. The analysis showed statistical significance of the model F=596.84 p<0.0001, with 49% predictiveness (R^2 =0.495). All factors ware significantly associated with NET - BMI: B= 0.213; Age: B= 2.662; Gender: B=1.011 p<0.0001.The girls presented with a significantly higher number of erupted permanent teeth.

DISCUSSION

The current investigation has a substantial contribution in the field of exploring the link between obesity and the timing of tooth eruption. It is the first of its kind in Bulgaria, with large sample size, allowing a reliable examination of age-specific comparisons between obese and non-obese participants.

The results from the current survey coincide with those, seen in the literature. A longitudinal study conducted over a 4-year period in 88 Mexican schoolchildren found a significant relationship between BMI and tooth eruption patterns[14], where at the age of 7.1, overweight children had 4.29 more teeth erupted on average than children classified as "thin" (BMI between the 5th and less than the 50th percentiles).

One study among 102, 12-year-old-children in Hong Kong found that sexual maturity is associated with body weight, height, and tooth eruption. Girls, classified into premature presented with a greater number of erupted permanent canines, premolars and second molars, compared with those with delayed maturation [15].

Must A. et al., gathered data from three subsequent cycles (2001–2002, 2003–2004, 2005–2006) of NHANES to explore the effect of obesity on permanent tooth eruption among 5-14-year-old-children. It was estimated that obese children had 1.44 more erupted permanent teeth than nonobese, controlling for age, gender and race/ethnicity [8].

The investigation demonstrated a significant association between gender and eruption in favour of girls. This conflicts a recent cross-sectional study on this issue [16], where the authors found no difference in the eruption pattern in girls and boys. In general, the earlier eruption of permanent teeth in females is attributed to earlier onset of maturation, which is likely to affect the tooth eruption timing. The different trends in respect to the above-mentioned association reflect the complex nature of the eruptive process, influenced by many general and local factors.

There are several limitations of the survey. The analysis was able to examine only the cross-sectional association between obesity status and tooth eruption, without exploring the timing of the onset of obesity. There was no data for nutritional, socio-economic status, ethnicity, birth weight and height, which may have a serious impact on tooth eruption. It was impossible to determine the dental age, as no radiographs were available.

The findings in this study have clinical importance in regard to dental caries risk and risk for a malocclusion. Earlier tooth eruption may lead to increased oral health problems such as the greater prevalence of caries, malocclusion, crowding and impaired oral hygiene and gingivitis [17]. This should be highly considered by dental and medical clinicians and may inquire a specific preventive program and appropriate treatment plan when managing overweight and obese paediatric patients.

CONCLUSION

Increased BMI and being female is associated with accelerated permanent tooth eruption. Further investigations may reveal the exact mechanisms underlying this correlation.

Abbreviations:
NET – Number of erupted permanent teeth
BMI – Body Mass Index

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