

### Research Report

## The effect of body mass index on tooth eruption and dental caries

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### ABSTRACT

**Background:** Children were compared to their siblings, cousins or peers regarding the eruption of their permanent teeth. Genetic and environmental factors can affect dental development and, therefore, the body mass index (BMI) could be considered as a factor that may influence dental development. **Purpose:** To determine any possible association between BMI and either dental caries or the eruption of permanent teeth (central incisor and molar). **Methods:** A cross-sectional study was completed for six-year-old school children. A total of 218 children (116 boys, 102 girls) from public elementary schools in Erbil City were entered into the study. Dental caries assessments were carried out using the WHO criteria for decayed, missing and filled primary teeth and indices (DMFT). BMI was used to classify obesity status. **Results:** Overall, 27.98% of the children were classified as overweight, 59.17% as normal and 12.84% as underweight. The DMFT was 5.247, while 12.39% of the children were caries-free. **Conclusions:** Children of normal weight had most permanent teeth erupted and a low caries index. Underweight children had fewer erupted teeth and a higher caries index. The complex relationship between body composition and oral health should be considered in paediatric patients.

**Keywords:** body mass index; DMFT; eruption of central incisors and molars

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### INTRODUCTION

Eruption of the teeth is positively related to the somatic growth (height and weight) of an individual. Many studies worldwide describe how poor nutrition during the growth period adversely influences aspects of dental development, including delaying the eruption of deciduous and permanent teeth. The prevalence of overweight and obese children is increasing worldwide, including in Europe.<sup>1</sup> This marked increase in body weight was described by the World Health Organisation (2003) as a 'global epidemic disease'. Obesity can be defined as a condition in which the energy intake becomes higher than the required energy, leading to deposition of body fat. This accumulation of extra fat within the body may have either environmental or genetic causes.<sup>2</sup> Being overweight causes health problems in children, both directly and over time, including: type II diabetes, metabolic problems, high blood pressure, hypercholesterolaemia, hyperandrogenism, orthopaedic complications, sleep disorders, cardiovascular disease and behavioural issues.<sup>3</sup>

The obesity trend in children and adolescents between six and seventeen years old in the US is characterised by differences in relation to age, gender, race-ethnicity, income and level of education. Representative surveys performed from 1963–1994 to measure weight and height showed 11% of the population to be obese in the period from 1988–1994. This level of obesity was not related to race-ethnicity, income or education. Obesity levels became higher over time, with the largest increase in the period from 1976–1994. The reasons for this fast increase in obesity in the US population is unclear but could be a sign of societal influence.<sup>4</sup>

According to the IOTF (International Obesity Task Force), the level of obesity in Italian children between eight and nine years of age varies from 16.6% in the south of Italy to about 7.5% in the north.<sup>5</sup> In France, 15.8% of children from seven to nine years old are overweight, with nearly 2.8% being obese.<sup>6</sup> This study presents the distribution of children according to BMI (categorised as underweight, normal weight or overweight) in Erbil City primary schools,

the relationship between BMI and eruption of the teeth (central incisors and molars), and the association between BMI and the level of dental caries (DMFT).

### MATERIALS AND METHODS

The study was carried out from January 2019 until the end of May 2019 including diagnosis, sample collection and data analysis. Approval was obtained from the Ministry of Education to diagnose the students (No. 08/18, on 23-12-2018). Before starting the study, the aims of the research were explained to each school manager and written approval was obtained from parents for participation of their child in the study.

The study sample included 218 six-year-old children from five governmental primary schools in Erbil City in Iraq, including 116 males and 102 females. All six-year-olds were invited to participate. Students with systemic diseases were excluded from the study.

BMI is calculated in the same manner for adults and children, although there are differences in the recommended amounts of body fat based on age and gender.<sup>7</sup> The BMI represents the ratio of weight (kg) to height (m), i.e.  $BMI = WEIGHT / HEIGHT^2$ .<sup>8</sup>

Weight status was defined by gender-related BMI according to the Centres for Disease Control and Prevention (CDC) guidelines as follows:<sup>9</sup> underweight (BMI  $\leq 5^{th}$  percentile), normal weight (BMI  $>5^{th}$  and  $<85^{th}$  percentile), at risk of overweight (BMI  $\geq 85^{th}$  and  $<95^{th}$  percentile), overweight (BMI  $\geq 95^{th}$  percentile) (see Table 1).

Instruments and supplies used during sample collection included gloves and masks, dental mirrors, dental probes,

height measuring tape (Yishen measuring tape, China) and bathroom scales (Tianshan brand penguin electronic scales, China).

Before each examination the procedure and instructions were explained to the children. Height and weight were measured for each child, after which the teeth were examined while the students were seated in their classroom. The examiner stood in front of each student’s chair for diagnosis. Data analysis and processing were carried out using the statistical package for social science (SPSS), version 20 (IBM, New York, USA).

### RESULTS

The eruption of central incisors and molars was calculated in relation to BMI. Table 2 shows the number and percentage of erupted and non-erupted central incisors and molars for the sample group.

The data shows that 12% of children were free of caries and therefore the dental caries prevalence was 88%. The DMFT was 5.2, with the highest percentage in the underweight group (Table 3).

No significant difference was observed in BMI between genders. More central incisors and molars had erupted in the overweight group and fewest in the underweight group, but this was not statistically significant. Most caries-free children were present in the normal weight group and fewest in the underweight group, again with no significant difference. The DMFT was highest in underweight children and lowest in those of normal weight but, as before, this difference was not significant (Table 4).

**Table 1.** Categories according to BMI

Variables	Categories	No.	%
Gender	Male	116	53.2
	Female	102	46.8
BMI	Under weight	28	12.8
	Normal weight	129	59.2
	Over weight	61	28.0

**Table 2.** The eruption of permanent centrals and molars

Variables	Categories	No.	%
Eruption of central incisors	Not erupted	49	22.5
	Erupted	169	77.5
Eruption of molars	Not erupted	37	17.0
	Erupted	181	83.0
DMFT categories	Caries free	20	9.2
	DMFT	198	90.8
Total		218	100

**Table 3.** Caries free and DMFT in BMI categories

BMI	Underweight	Normal weight	Overweight	Total (all types)
Caries free	2(7.14%)	18(13.95%)	7(11.48%)	27(12.39%)
DMFT	6.142	5.116	5.114	5.247

**Table 4.** The relation between BMI and the other variables

Variables	Categories	BMI			P
		Under weight	Normal weight	Over weight	
Gender	Male	13 (46.4%)	70 (54.3%)	33 (54.1%)	0.743
	Female	15 (53.6%)	59 (45.7%)	28 (45.9%)	
Eruption of central incisors	Not erupted	8 (28.6%)	33 (25.6%)	8 (13.1%)	0.112
	Erupted	20 (71.4%)	96 (74.4%)	53 (86.9%)	
Eruption of molars	Not erupted	7 (25%)	22 (17.1%)	8 (13.1%)	0.401
	Erupted	21 (75%)	107 (82.9%)	53 (86.9%)	
DMFT categories	Caries free	2 (7.1%)	13 (10.1%)	5 (8.2%)	0.944
	DMFT	26 (92.9%)	116 (89.9%)	56 (91.8%)	
Total		28 (100%)	129 (100%)	61 (100%)	

## DISCUSSION

In this study, most children were of normal weight and the lowest proportion was underweight, a similar distribution to that found by Najmeh *et al.*<sup>10</sup> However, different results were recorded by Lobstein *et al.*<sup>11</sup> Many studies have shown that the proportion of overweight children in both developing and developed countries is increasing, making it a significant public health concern.<sup>12</sup>

A higher percentage of females were evident in the underweight category, while the proportion of males was higher in the normal and overweight groups. This may be related to males having a greater acceptance of different food types than females. This finding is in agreement with the findings of the 2015 National Health and Nutrition Examination Survey.<sup>13</sup> However, in contrast to our study obesity rates were higher in girls than in boys, potentially because most of the boys were significantly more active and more likely to meet physical activity guidelines than the girls.<sup>14</sup>

Tooth eruption is a growth process and so is related to other body factors such as height and weight.<sup>15</sup> The relationship between BMI and eruption of the central incisors and molars was strongest in the overweight category and weakest in the underweight category. This could be due to effects of good nutrition on the eruption of the teeth, as previously reported by Must *et al.*<sup>16</sup> who found that obese children were more likely to have a high number of erupted teeth than non-obese children. Other studies have also reported comparable results.<sup>17,18</sup>

In contrast, Elamin *et al.*<sup>19</sup> studied tooth development in malnourished Sudanese children and found that sustained malnutrition during childhood had little effect on dental development in this population. Moreover, Eid *et al.*<sup>20</sup> found no significant correlation between dental maturation and BMI in Brazilian children aged between six and fourteen.

This study found that 12.39% of the children were caries-free. In comparison, Costacurta *et al.*<sup>21</sup> found a higher proportion to be caries-free (16.82%). The normal weight

group had the highest proportion of caries-free children, whilst the underweight group showed the lowest.

Malnutrition in children could also increase the risk of caries. It was found that there is an association between dental caries (DMFT) and nutrition, as this data shows the highest proportion of dental caries in the underweight category but comparable rates in the normal and overweight categories. In contrast to our study, dental caries and being overweight are concomitant situations in many communities due to risk factors such as high intake of calories and carbohydrate. Surveys by Werner *et al.*<sup>22</sup>, Kantovitz *et al.*<sup>23</sup> and Gatta *et al.*<sup>15</sup> showed that cariogenic foods may play a significant role in dental caries, suggesting a relationship between caries and body weight after the age of six.<sup>24</sup> However, other studies showed no association between childhood weight and dental caries.<sup>12,25–29</sup>

From the results of this study, we can conclude that underweight children may experience delays in tooth eruption and higher dental caries than normal weight and overweight children. This could be attributed to effects of diet on the eruption of teeth, with adequate nutrition protecting against dental caries. We conclude that children of normal weight and overweight children have more erupted permanent teeth and lower dental caries. The complicated association between oral health and body composition must be taken into consideration when treating paediatric patients.

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