



# Timing of Permanent Tooth Emergence is Associated with Overweight/Obesity in Children from the Amazon Region

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The aim of this study was to evaluate the association between timing of permanent tooth emergence with overweight and obesity in children from Brazilian Amazon region. The studied population consisted of 192 children, 09 to 12 year-old, from public schools at Manaus, Amazonas-Brazil. Clinical examination was performed and the tooth emergence was evaluated according to the number of permanent erupted teeth. Body mass index z-score was calculated. For the statistical analysis 'Overweight/obese' group was compared with 'Normal weight' group in a case to control ratio 1:2. The t-test based on age was used for means comparison between the groups. A linear regression analysis using age and gender as co-variants was used. The established alpha was 5%. One hundred twenty-seven children were classified as normal weight and 65 were classified as overweight/obese (49 were overweight and 16 were obese). Overweight/obesity condition was associated with the gender, in which boys had a higher chance to present higher weight conditions (OR=1.84; CI 95% 1.06-3.37; p=0.04). The mean number of permanent teeth was higher in the overweight/obesity group (p<0.001). Linear regression analysis demonstrated that nutritional status, gender and age were strongly associated with number of permanent erupted teeth (p<0.05). In conclusion, our study demonstrated that timing of permanent tooth emergence is associated with overweight/obesity in children from Manaus, Brazil.

Key Words: tooth emergence; nutritional status; children.

## Introduction

Childhood overweight/obesity is one of the most serious public health challenges of the 21st century and has been increasing during the past years. According to the World Health Organization (WHO) over 42 million children are considered overweight or obese. It is well known that obesity is associated to adversely health issues, including earlier puberty (1). Overweight children are taller than non-overweight children at the same age (2).

Tooth emergence is the result of an intricate process, characterized by the movement of the tooth, during odontogenesis, through the alveolar bone and gingival mucosa until the tooth emergence in the proper position in the dental arches<sup>1</sup>. The mechanisms involved in the timing of tooth emergence are not completely understood and are influenced by many regulatory aspects (1,2).

Several studies have already shown that the timing of tooth emergence can be influenced by the nutritional status, such as malnourished, overweight and obesity (3-11). Although previous studies in different populations demonstrated that obese and overweight children have more permanent erupted teeth when compared with their controls (3,5-7,9-11), none of these studies were performed

in a population of children from the Amazon forest region, which has a completely different genetic, environmental and cultural background. Thus, the aim of this study was to evaluate if overweight and obesity is associated with timing of permanent tooth emergence in children from the Brazilian amazon region.

## Material and Methods

### Participants

The study was approved by The Human Ethics Committee of Amazon State University (Nº 923.569). Informed written consent was obtained from the parents and age appropriate assent document were used for all children.

Children from four public schools from Manaus city were evaluated. Manaus is the capital city of the state of Amazonas state that is locate in the Northern Region of Brazil. Manaus is situated in the middle of the Amazon rainforest and the total population comprises 2,094,391 inhabitants. The ancestry of the inhabitants of Manaus is composed mainly by European and Native American, and the remaining of African descendant (12).

The parents or legal guardians answered a questionnaire about information regarding their child's medical history

and actual health condition on order to evaluate if the weight deviation were associated with any comorbidity. Non-syndromic children aged from 9 to 12 years old were included. Underweight/malnourished children were not included.

#### Determination of Timing of Tooth Emergence

Two specialists in pediatric dentistry (KRFV and SSE) performed the oral examination. The examination was performed in the schoolyard with sunlight as a direct light source. After brushing their teeth, the students were placed in a supine position. Tooth emergence was evaluated according to the number of permanent teeth erupted, which was defined as having occurred if any tooth surface had emerged the alveolar mucosa<sup>8</sup>.

#### Determination of the Nutritional Status

Heights were determined in meters and weights in kilograms with a weighing machine. The children were wearing light clothes and no shoes.

The nutritional status were calculated using the Body Mass Index (BMI) z-score calculator (<http://zscore.research.chop.edu/index.php>) and individual height, weight, age and gender as variables.

The classification was performed according to the World Health Organization<sup>12</sup>, as follow:

Overweight/obese group: BMI z-score >85th percentile;

Normal weight children: BMI z-score  $\geq 3$  and  $\leq 85$ th percentile.

#### Statistical Analysis

For the statistical analysis 'Overweight/obese' group was compared with 'Normal weight' group were compared with normal weight children in a case to control ratio 1:2.

Data were analyzed using Epi Info 7. The Shapiro-Wilk test was used to verify the normality of the data. The t-test based on age was used for means comparison between the groups. A linear regression analysis using age and gender as co-variants was used. The established alpha was 5% for all comparisons.

The power was calculated using clinical.com (<http://clincalc.com/stats/Power.aspx>) to calculate the power for

Table 1. Sample characteristics distribution between the groups.

| Characteristics | Groups        |                    | p-value |
|-----------------|---------------|--------------------|---------|
|                 | Normal weight | Overweight/obesity |         |
| Sex             |               |                    |         |
| Male            | N=55 (43.31%) | N=38 (40.9%)       | 0.04*   |
| Female          | N=72 (56.69%) | N=27 (27.3%)       |         |
| Mean age (SD)   | 10.40 (+8.18) | 10.22 (+0.94)      | 0.21    |

SD: standard deviation; \*statistically significant difference (p<0.05).

comparison of means from independent samples.

## Results

Normal weight group had 127 children and overweight/obese group had 65 children (49 were overweight, and 16 were obese). The characteristics distribution according to the groups is presented in Table 1. Overweight/obesity were associated with the gender, in which boys had a greater chance to present higher weight conditions (OR=1.84; CI 95% 1.06–3.37; p=0.04).

In the normal weight group, 1 child had a medical history of severe premature birth, one child had iron deficiency anemia, one child had high triglycerides, 7 children had allergies condition, 4 children had asthma, and one has attention deficit hyperactivity disorder-ADHD. In the overweight/obesity, 1 child had high triglycerides, 2 children had allergies conditions and 2 children had asthma. There was no association between the medical history and overweight/obese (p>0.05).

The mean number of permanent teeth was higher in the overweight/obesity group. An association was observed when the analysis was performed in both genders, in males only and in females only (p<0.001). The mean distribution according to the nutritional status and stratified according to the gender is presented in the Table 2.

Table 3 shows the linear regression analysis results of the factors involved in the number of permanent erupted teeth. Nutritional status, gender and age were strongly associated with number of permanent erupted teeth (p<0.05).

The power calculation using the actual sample sizes for normal weight and overweight/obese groups show that the power is 84.3% to detect the difference between groups.

Table 2. Range and mean number of permanent erupted teeth according to the groups and stratified according to the sex.

| Groups/Nutritional status | Number of erupted teeth |              | p-value |
|---------------------------|-------------------------|--------------|---------|
|                           | Minimum-maximum         | Mean (SD)    |         |
| Both sexes                |                         |              |         |
| Normal Weight             | 10-28                   | 20.36 (5.25) | <0.001* |
| Overweight/obesity        | 12-28                   | 22.63 (4.89) |         |
| Males                     |                         |              |         |
| Normal Weight             | 10-28                   | 18.86 (4.78) | <0.001* |
| Overweight/obesity        | 12-28                   | 21.48 (4.98) |         |
| Females                   |                         |              |         |
| Normal Weight             | 10-28                   | 21.47 (5.31) | <0.001* |
| Overweight/obesity        | 14-28                   | 24.21 (4.30) |         |

SD: standard deviation; \* statistically significant difference (p<0.05)

## Discussion

The childhood overweight and obesity is a serious public health problem. This problem is global and is progressively affecting many low- and middle-income countries, mainly in urban areas (12). This study was performed in the capital of the Amazonas state- Brazil. Manaus is an urban area and is the largest city in northern of Brazil and represents the sixth largest economy of the country (13).

The health burden from overweight and obesity is the driving factor behind several research studies regarding the impact of nutritional status conditions on oral health. It is known that nutritional status plays a role in children's oral health and development (14), but some aspects and the nature of this relationship remain unclear.

The BMI z-score analysis is a useful tool to evaluate children's health and can be used to analyze the association between nutritional status with many aspects, such as dental, skeletal and motor development (15,16). In our study, we also used this method to classify children's nutritional status and evaluate if an association between higher BMI and tooth development exists.

Our study evaluated a singular population of children from the Brazilian Amazon Region, and we were able to note that our results were in agreement with previous studies performed in different populations, in which higher weight, mainly obesity, are associated with alterations in timing of tooth eruption (3,5-7,9,10). We observed that overweight/obese children had a statistical significant higher mean number of permanent teeth. This finding could be explained by the fact that overweight and obese children have hormonal metabolism alterations (5) and earlier puberty. So, it is possible that these are the mechanisms related to the alteration in the timing of tooth eruption.

It is well established that the gender is involved in the timing of tooth eruption (17-22). The analysis performed here also observed that girls had more erupted permanent teeth than boys. It is well established that girls mature earlier than boys, including the dental development (23,24). For this reason, our analysis stratified the sample according to the gender, in which, overweight/obese children in both genders had more erupted permanent teeth.

Comorbidities of pediatric obesity may be grouped under physical and psychosocial categories. Childhood obesity can adversely affect nearly every organ system and often has serious consequences, including hypertension, dyslipidemia, insulin resistance, prediabetes, type 2 diabetes mellitus, fatty liver disease and psychosocial complications (25). In the present study, we were not able to observe an association between overweight/obesity and health conditions. These could be explained by the fact that the medical history information was collected through a questionnaire, in which the parents/legal guardians failed to report some conditions. Other explanation could be the fact that obese children represent only 16 cases. Weight that is higher than what is considered as a healthy weight for a given height is described as overweight or obese, however, it is possible that only the severer phenotype (obesity) is associated with comorbidities in childhood.

The sample recruitment ended in 65 overweight/obese and almost a twice of normal weight children. Although a sample size calculation was not performed during the study design, we provided a post-hoc power calculation, which demonstrated that this sample was sufficient to maintain the power of the cross-sectional study.

Some previous studies have shown that the time of tooth emergence varies according to the origin of the population (17-19,21,22,26,27). To the best of our knowledge, this is the first study to evaluate the impact of the overweight and obesity in the timing of tooth eruption in a population from the Amazon region, which presents a particular genetic background, with a mixture of Europeans descendants and Native South Americans, and indeed our study suggests that nutritional status are associated with dental development and time of tooth eruption in Amazon children.

Timing of permanent tooth emergence is associated with overweight and obesity in children from Manaus, Brazil.

## Resumo

O objetivo deste estudo foi avaliar se a erupção dentária está associada com sobrepeso/obesidade em crianças da região Amazônica brasileira. A população estudada foi composta por 192 crianças, de 9 a 12 anos, de escolas públicas de Manaus, Amazonas-Brasil. O exame clínico foi realizado e a erupção dentária foi avaliada de acordo com o número de dentes permanentes irrompidos. O índice de massa corporal escore-z foi calculado. Para a análise estatística, comparou-se o grupo "sobrepeso / obesidade" com o grupo "peso normal" em uma proporção de controle 1: 2. O teste t baseado na idade foi utilizado para comparação das médias entre os grupos. Uma análise de regressão linear usando idade e sexo como co-variáveis foi utilizada. O alfa estabelecido foi de 5%. Cento e vinte e sete crianças foram classificadas com peso normal e 65 foram classificadas com sobrepeso / obesidade (49 com sobrepeso e 16 com obesidade). A condição de sobrepeso / obesidade associou-se ao gênero, no qual os meninos tiveram maior chance de apresentar condições de maior peso (OR = 1,84; IC 95% 1,06-3,37; p = 0,04). O número médio de dentes permanentes irrompidos foi maior no grupo sobrepeso /

Table 3. Factors influencing the number of permanent erupted teeth.

| R <sup>2</sup>        | 0.43 |         |
|-----------------------|------|---------|
| Independent variables | SE   | p-value |
| Nutritional status    | 0.62 | 0.001*  |
| Sex                   | 0.59 | 0.025*  |
| Age                   | 0.32 | <0.001* |

SE means standard error. \*statistically significant difference (p<0.05)

obesidade ( $p < 0,001$ ). A análise de regressão linear demonstrou que o estado nutricional, sexo e idade foram fortemente associados ao número de dentes permanentes irrompidos ( $p < 0,05$ ). Concluindo, nosso estudo demonstrou que o momento da erupção dos dentes permanentes é associado com sobrepeso / obesidade em crianças de Manaus, Brasil.

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