

## Prevalence of malocclusion in obese children

## Prevalência de má-oclusão em crianças com obesidade

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## ABSTRACT

**Objective:** To verify the prevalence of malocclusion in children being treated at the Children's Obesity Center at the Varela Santiago Children's Hospital in Natal, Rio Grande do Norte. **Methods:** Children of both sexes aged between 7 and 10 years were examined. The data of interest was collected through a clinical examination to detect malocclusions using the Dental Aesthetic Index, and nutritional data from medical records. The data obtained was organized and tabulated in spreadsheets and processed and analyzed using the Jamovi® statistical program. The comparison between patients with malocclusion and the independent variables was checked using the one-way ANOVA and Chi-square tests. Logistic regression was used to assess the effect of the variables on the presence of malocclusion. Results with  $p$ -values  $\leq 0.05$

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were considered statistically significant. **Results:** 66 children were assessed, of whom 35 (53%) were male and 31 (47%) female. The prevalence of malocclusion was 54.54%, with no difference between genders. Significantly higher body mass index and weight values were observed in children with definite malocclusion. No variable studied had a significant impact on malocclusion in obese children. **Conclusion:** Children with a definite malocclusion had significantly higher body mass index and weight. However, obesity seems not to be a determinant factor on malocclusion development.

**Indexing terms:** Child. Malocclusion. Obesity.

## RESUMO

**Objetivo:** Verificar a prevalência da má oclusão em crianças em tratamento no Núcleo de Obesidade Infantil, no Hospital Infantil Varela Santiago, em Natal, Rio Grande do Norte. **Métodos:** Foram examinadas crianças de ambos os sexos, com faixa etária de 7 a 10 anos. O recolhimento dos dados de interesse foi feito através de exame clínico para detecção de más oclusões por meio do Dental Aesthetic Index, e coleta dos dados nutricionais das fichas médicas. Os dados obtidos foram organizados e tabulados em planilhas, além de processados e analisados através do programa estatístico Jamovi®. A comparação dos pacientes com má oclusão e as variáveis independentes foi averiguada através dos testes ANOVA one-way e Qui-quadrado. Para avaliar o efeito das variáveis sobre a presença da má oclusão, foi utilizada regressão logística. Foram considerados estatisticamente significativos os resultados com valores de  $p \leq 0,05$ . **Resultados:** Foram avaliadas 66 crianças, das quais 35 (53%) eram do sexo masculino e 31 (47%) do sexo feminino. A prevalência de má oclusão foi de 54,54%, sem diferença entre os gêneros. Valores significativamente maiores de índice de massa corporal e peso foram observados em crianças com má oclusão definida. Nenhuma variável estudada impactou significativamente na má oclusão de crianças obesas. **Conclusão:** Crianças com má oclusão definida apresentam maior peso e índice de massa corporal, entretanto a obesidade parece não ser um fator determinante no desenvolvimento da má oclusão.

**Termos de indexação:** Criança. Má oclusão. Obesidade.

## INTRODUCTION

Malocclusion is a developmental alteration of the teeth and/or dental arches that can occur in both the deciduous and permanent dentitions, with aesthetic and functional repercussions [1]. It is considered a global public health issue by the World Health Organization (WHO) due to its high prevalence. Malocclusions can have a social impact by negatively affecting the quality of life of affected individuals, impairing social interaction and psychological well-being [2-4].

Currently, a higher prevalence of malocclusion has been observed in Brazil, particularly among preschool-aged children, with a reported increase of 28.2% over a five-year period and prevalence rates ranging from 28% to 80%, depending on geographic location [5]. Malocclusions may be associated with several factors, such as non-nutritive sucking habits (e.g., thumb or pacifier use), trauma, and dental caries. Carious lesions are expected in children with high sugar intake, which is why individuals with obesity tend to have a higher prevalence of dental caries [6].

Obesity is a chronic disease of complex and multifactorial etiology, defined by the WHO as the abnormal or excessive accumulation of body fat [7]. The modern environment plays a major role in promoting obesity, with decreasing levels of physical activity and increasing caloric intake, especially through processed, ready-to-eat foods, being strong environmental determinants [8]. This dietary pattern

is also part of the complex network of risk factors for malocclusion, particularly due to the increased risk of caries development.

Individuals with obesity present high levels of leptin, a hormone involved in satiety, which leads to leptin resistance at receptor sites. Leptin also acts as a growth factor with a peripheral effect on skeletal growth centers, potentially causing changes in craniofacial morphology in children, as well as early maturation and eruption of teeth, thereby impacting occlusal development [9].

However, to date, no studies have investigated the occlusal characteristics of obese children. Therefore, the aim of the present study was to evaluate the prevalence of malocclusion in children with obesity.

## METHODS

The integrity, privacy, confidentiality, and anonymity of patient information were respected, and the study was approved by the Research Ethics Committee involving Human Subjects of the Federal University of Rio Grande do Norte (Approval No. 6.230.140). Children and their legal guardians were invited to sign the Informed Assent Form and the Informed Consent Form, respectively.

This was an observational, cross-sectional study. The sample consisted of children of both sexes, aged 7 to 10 years, who were receiving care at the Pediatric Obesity Treatment Center of the Varela Santiago Children's Hospital in Natal, Rio Grande do Norte, Brazil. Children who had previously undergone or were currently undergoing orthodontic treatment were excluded. The sample size was determined using a sample size calculation based on data from a previous study [10]. The calculation was performed considering a 95% confidence level, estimating a malocclusion prevalence of 69% [10] and an obesity prevalence of 12% [11] among children. The result indicated that a minimum of 66 children would be required. The clinical examination was conducted by a single examiner in a private room previously reserved at the Pediatric Obesity Treatment Center. Each child was seated facing the examiner, under natural light, and evaluated through direct inspection of the oral cavity using a disposable wooden spatula, a transparent ruler, and sterile gauze to dry the teeth. The data were recorded by an assistant on a clinical dental chart developed specifically for this study.

The index chosen to classify the severity of malocclusion was the Dental Aesthetic Index (DAI), which provides a single score linking dental aesthetic perception with objective measurements associated with malocclusion. As an adaptation for the mixed dentition stage, the number of missing incisors, canines, and premolars was not counted. Therefore, the space resulting from the exfoliation of a deciduous tooth was not included in the "missing teeth" score of the DAI formula if the permanent tooth had not yet erupted [12]. According to the scores obtained, children were classified into the following categories of malocclusion severity:

Score  $\leq 25$ : normal occlusion or minor malocclusion, no treatment required;

Score 26–30: defined malocclusion, elective treatment recommended;

Score 31–35: severe malocclusion, treatment highly desirable;

Score  $\geq 36$ : very severe or handicapping malocclusion, treatment mandatory.

The variables investigated in this study included malocclusion (dependent variable), gender, age, Body Mass Index (BMI), weight, and body fat percentage. The clinical data regarding the physical assessment

of the children were retrieved from the nutritional and endocrinological records of the Varela Santiago Hospital.

Data were organized and tabulated using Microsoft Office Excel spreadsheets, and processed and analyzed using Jamovi® software (The Jamovi Project, Sydney, Australia), version 1.6. The Kolmogorov-Smirnov test was used to assess data normality. Comparisons between patients based on malocclusion status and independent variables were performed using one-way ANOVA and Chi-square tests. Logistic regression was used to explain the effect of the variables on the presence of malocclusion. Pearson’s correlation coefficient was applied to evaluate the association between the DAI and obesity indicators. Results with  $p \leq 0.05$  were considered statistically significant.

Additionally, this study was conducted in accordance with the ethical principles of the Declaration of Helsinki (2000) and in compliance with Brazilian regulations governing health research.

RESULTS

A total of 66 children were evaluated, of whom 35 (53%) were boys and 31 (47%) were girls. The prevalence of malocclusion was found to be 54.54%. The means and proportions of the variables analyzed are presented in Table 1. Significantly higher values of BMI and weight were observed in children with defined malocclusion.

**Table 1.** Characteristics of children with malocclusion according to age, gender, BMI, body fat percentage, and weight.

Variables	Normal occlusion (n=30)	Defined malocclusion (n=19)	Severe malocclusion (n=10)	Very severe malocclusion (n=7)	Total (n=66)	<i>p</i>
	M (SD)					
Age	8.23 (1.17)	9.58 (1.50)	8.50 (1.65)	9.00 (1.41)	8.74 (1.46)	0.053*
Gender						
Male	20 (57.1)	8 (22.9)	3 (8.6)	4 (11.4)	35 (100)	0.149#
Female	10 (32.3)	11 (35.5)	7 (22.6)	3 (9.7)	31 (100)	
BMI	24.8 (5.00) <sup>b</sup>	27.4 (5.30) <sup>a</sup>	26.7 (6.19) <sup>ab</sup>	22.1 (2.41) <sup>b</sup>	25.6 (5.24)	0.014* <sup>t</sup>
Body fat percentage	39.8 (8.63)	41.6 (8.93)	42.9 (6.50)	33.9 (6.21)	40.2 (8.41)	0.057*
Weight	48.2 (12.9) <sup>b</sup>	61.7 (16.7) <sup>a</sup>	52.00 (15.8) <sup>ab</sup>	43.7 (9.16) <sup>b</sup>	52.3 (15.4)	0.017*

Source: authors (2024).  
Note: \*ANOVA One-Way, <sup>t</sup>Tukey’s post hoc test, #Chi-square test. <sup>a,b</sup>Different letters indicate statistically significant differences between groups ( $p < 0.05$ ), according to Tukey’s post hoc test. <sup>ab</sup>No statistically significant difference from groups marked with “a” or “b”. <sup>t</sup>Indicates a statistically significant difference found by one-way ANOVA followed by Tukey’s post hoc test. BMI: Body Mass Index; M: Mean; SD: Standard Deviation.

The multinomial logistic regression analysis revealed that none of the studied variables had a statistically significant impact on malocclusion in obese children (Table 2). Furthermore, no correlation was found between the independent variables and the DAI score (Table 3).

**Table 2.** Multinomial logistic regression considering malocclusion as the dependent variable.

Variables	Defined malocclusion versus normal occlusion			Severe malocclusion versus normal occlusion			Very severe malocclusion versus normal occlusion		
	OR	p	CI 95%	OR	p	CI 95%	OR	p	CI 95%
BMI	1.10	0.092	0.98-1.24	1.07	0.282	0.93-1.24	0.84	0.178	0.66-1.08
Body fat percentage	1.02	0.441	0.95-1.11	1.05	0.281	0.95-1.16	0.92	0.119	0.84-1.02
Weight	1.06	0.005	1.01-1.11	1.02	0.339	0.97-1.07	0.96	0.401	0.89-1.04
Gender									
Male	0.19 1	0.155	0.02-1.84	0.58 1	0.375	0.18-1.90	0.51 1	0.246	0.17-1.5
Female	—	—	—	—	—	—	—	—	—
Age	1.17	0.574	0.67-2.05	1.20	0.314	0.83-1.74	1.14	0.422	0.81-1.61

Source: authors (2024).  
Note: BMI: Body Mass Index; CI: Confiance Interval; OR: *Odds Ratio*.

**Table 3.** Pearson’s correlation between the DAI and the independent variables.

Variables	DAI		
	r	p	CI 95%
BMI	-0.103	0.411	-0.33-1.43
Body fat percentage	-0.100	0.424	-0.33-0.14
Weight	-0.034	0.784	-0.27-0.20

Source: authors (2024).

Note: BMI: Body Mass Index; CI: Confiance Interval; DAI: Dental Aesthetic Index.

DISCUSSION

The present study aimed to identify the prevalence of malocclusion in obese children. To the best of our knowledge, this is the first study to investigate potential occlusal alterations in children with obesity. Our findings revealed a malocclusion prevalence of 54.54%, with no significant differences between genders. Moreover, children with defined malocclusion presented significantly higher weight and BMI compared to other children.

The prevalence rate of malocclusion observed in obese children was similar to values reported in the literature for non-obese children. A recent systematic review indicated that 56% of children and adolescents exhibit some type of malocclusion, and prevalence rates vary across regions and countries due to differences in methodologies, diagnostic criteria, and age groups assessed [13]. Recent studies have not shown a significant association between malocclusion and gender. Although small differences may be observed between boys and girls, the statistical results are generally not significant [14,15]. The present study reflects these findings, showing consistent data, as no gender-based differences in the prevalence of malocclusion were observed.

Our results indicated that children with defined malocclusion had higher weight and BMI. However, due to the novelty of this investigation, comparisons with other studies should be made with caution. The literature suggests that childhood obesity may affect the craniofacial morphology of growing patients, with associated features such as increased maxillary and mandibular dimensions, less convex facial profiles, reduced mandibular plane angle, and decreased anterior and posterior facial heights.

This relationship may be explained by the action of leptin, a hormone mainly produced by white adipose tissue that regulates appetite and energy storage. Leptin plays a direct role in skeletal growth by stimulating the release of Gonadotropin-Releasing Hormone (GnRH) in the hypothalamus and acting on the anterior pituitary to accelerate pubertal development. Consequently, obese patients often exhibit elevated leptin levels, which may influence the emergence of malocclusions [9].

However, our results showed that none of the variables studied had a statistically significant impact on the presence of malocclusion in obese children. Therefore, obesity alone does not appear to be a determining factor in the development of malocclusion. This may be attributed to the multifactorial nature of malocclusion etiology, which involves a complex interaction of genetic, congenital, morphological, and environmental factors [16].

Among the environmental factors, dental caries play a major role in the development of malocclusion, especially when lesions are extensive and lead to tooth loss. When space maintenance is not provided following premature tooth loss, the likelihood of developing malocclusion increases [17].

Considering the multifactorial origin of malocclusion, obesity appears to play only a minor role in its development. Nevertheless, it is speculated that obesity may act as an additional risk factor in children who already present other predisposing conditions. Even so, our results showed that higher weight and BMI were associated with defined malocclusion, which represents the milder form of the condition. This supports the hypothesis that other factors exert greater influence in explaining more severe forms of malocclusion, suggesting that the role of obesity in this context is relatively limited.

As this is a cross-sectional study, it is not possible to establish causal relationships between the variables studied. Additionally, another limitation lies in the absence of a control group, which could have provided a crucial comparative reference for the experimental group. The lack of such a group may influence the interpretation of results, particularly in determining the true impact of the studied variables.

Thus, longitudinal studies are recommended, with larger sample sizes and the inclusion of non-obese children, to enable more comprehensive analysis and better understanding of the role of obesity in the development of malocclusion.

## CONCLUSION

The prevalence of malocclusion in obese children was 54.54%. Additionally, children with defined malocclusion presented higher weight and BMI; however, obesity does not appear to be a determining factor in the development of malocclusion.

Conflict of interest: The authors declare that there are no conflicts of interest.

## Collaborators

JLM Cabral, conceptualization, data curation, formal analysis, investigation, methodology, writing – original draft. DA Macedo, investigation, methodology, writing – review & editing. LL Costa, supervision, writing – review & editing. LM Lemos, supervision, writing – review & editing. PBD Santos, methodology, supervision, validation, writing – review & editing.

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