








Is Low Income Associated with Malocclusion in Primary Dentition Among Preschoolers?

Jessa Iashmin Alcobaça Gomes Machado¹, Natália Silva Andrade², Renara Natália Cerqueira Silva³, Marcus Vinícius Nunes Neiva do Rego¹, Lúcia de Fátima Almeida de Deus Moura³, Wagner Leal de Moura¹, Marina de Deus Moura de Lima³

¹Specialization Course in Orthodontics, School of Dentistry, Federal University of Piauí, Teresina, PI, Brazil.

²Postgraduate Program in Dental Sciences, School of Dentistry, University of São Paulo, São Paulo, SP, Brazil.

³Postgraduate Program in Dentistry, School of Dentistry, Federal University of Piauí, Teresina, PI, Brazil.

Author to whom correspondence should be addressed: Jessa Iashmin Alcobaça Gomes Machado, Universidade Federal do Piauí, Programa de Pós-graduação em Odontologia, Ministro Petrônio Portela Campus, Bloco 5, Ininga, Teresina, Piauí, Brazil. 64049-550. Phone: +55 86 3237-1517. E-mail: jes.iagm@gmail.com.

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Abstract

Objective: To determine the prevalence and factors associated with malocclusion in the primary dentition of preschool children in a city of Brazilian Northeast. **Material and Methods:** A cross-sectional study was conducted with 566 five-years-old preschool children who were enrolled in public and private preschools in the city of Teresina, Piauí, Brazil. Data were collected using a sociodemographic questionnaire administrated to parents/caregivers and clinical oral examination of the children was performed. Foster and Hamilton Index for primary teeth was used for the diagnosis of malocclusions. Descriptive analysis was carried out and Poisson regression was used to assesses the association with independent variables. **Results:** The prevalence of malocclusion was 51.2%. The most frequent types were Class II canines (17% and 16.8%), increased overjet (15.2%) and reduced overbite (14%). Anterior crossbite was present in 3.5% of the preschool children evaluated. There was an association between malocclusion and low family income (PR = 1.22; 95% CI = 1.01-1.47). **Conclusion:** The prevalence of malocclusion in the primary dentition was high and associated with a low family income.

Keywords: Orthodontics; Malocclusion; Tooth, Deciduous; Socioeconomic Factors.

Introduction

Malocclusion is characterized by an abnormal relationship between teeth and/or jaws, which can lead to problems with chewing, phonation and may negatively impact an individual's quality of life [1-4]. The prevalence of malocclusion in the primary dentition varies from 46.2 to 81.44% [1,5-8]. The variability of these frequencies occurs owing to the lack of standardization of the methodologies used [8].

Changes in dental relationships present a complex and multifactorial etiology and are predominantly determined by genetic factors. However, non-nutritive sucking habits, mouth breathing, a diet with refined foods, early weaning and premature loss of primary teeth are associated with malocclusion [9-11]. Currently, there is no consensus regarding the influence of socioeconomic and demographic factors [1,8,12], although a greater chance of malocclusion was observed among residents of the Midwest and Northeast of Brazil [13].

Increased overjet, deep overbite, crossbite, and open bite are the most frequent types of malocclusion in the primary dentition [5]. Some occlusal changes that settle early can self-correct, such as an open bite [14], but others, such as distocclusion and crossbite, may become worse [15,16]. In studies on the incidence of malocclusion, it was observed that the presence of malocclusion in the primary dentition is a risk factor for the need for orthodontic treatment in the permanent dentition, especially in Class II canines, anterior open bite and posterior crossbite [9-11]. In this context, conducting orthodontic examinations in preschoolers is important so that malocclusions are diagnosed early and the etiological factors can be identified and removed when possible [9].

Epidemiological research on the prevalence and factors associated with malocclusion in the primary dentition in different populations is important for the implementation of public policies focused on health services, in order to prevent the occurrence of more severe forms of malocclusion in the permanent dentition [8,17].

The aim of the present study was to determine the prevalence and factors associated with malocclusion in the primary dentition in preschool children from a city in the Brazilian Northeast.

Material and Methods

Sample Characteristics and Study Design

A preschool-based, cross-sectional study was conducted with a sample of 566 pairs of parents/caregivers and five-year-old-children enrolled in public and private preschools in the city of Teresina, Piauí, Brazil.

A two-stage sampling strategy selected the participants from a total population of 7,792 children in the age group. The sample was stratified according to the type (public or private) and preschool location (north, south, east and southeast) from a list provided by the Municipal Secretary of Education of Teresina-PI and the Syndicate of Private Schools of Teresina-PI. In the first stage, five preschools were randomly selected from each location and secondly, in each institution, children were drawn from school attendance lists. The sample size was calculated based on an estimated prevalence rate of malocclusion of 50%, 95% confidence interval, 5% margin of error and a correction factor of 1.6 for design effect. In addition, to minimize possible dropouts, the sample size was increased by 10%, for a total of 602 ($547 + 55 = 602$) preschoolers.

Eligibility Criteria

The participants included in the sample were preschoolers 5 years of age at the time of the clinical examination, with a complete primary dentition and no permanent first molars. Children with special needs, as

well as systemic and non-cooperative diseases identified during the clinical examination were considered ineligible for the study.

Training and Calibration Exercise

The theoretical-practical exercises were coordinated by a specialist in Orthodontics involved firstly a discussion regarding the diagnostic criteria for malocclusion and an analysis of photographs of teeth with and without malocclusion obtained at the Dental Clinic of the Federal University of Piauí was carried out. When the examiner (one dentist) and the specialist agreed on 80% of the assessments, the second phase of the calibration was initiated. In the clinical phase, children were clinically at two-time points with a minimum interval of 15 days between the two exams. Intra-examiner agreement was calculated ($Kappa = 0.82$ for malocclusion).

Pilot Study

A pilot study was carried out to evaluate the research methodology, with 10% of the sample (60 children) of three preschools (two public and one private). These children were not included in the final study sample and no changes were necessary in the methodology proposed for the study.

Data Collection

Data were collected using a sociodemographic questionnaire to parents/caregivers and based on a clinical dental examination of the children. Initially, the preschools were visited and the consent of the directors to carry out the study at the institution was obtained. The parents/caregivers then received a letter through the preschools informing them that their children had been selected to participate in the study and were informed of the study's objectives. Along with it, the Free and Informed Consent Term and sociodemographic questionnaire were sent. The questionnaires were collected, and the preschool children whose parents provided the answered forms, were examined.

The sociodemographic characteristics were evaluated by means of a questionnaire, which contained information about child's gender, monthly family income (categorized based on the average income in Brazil - two minimum wages, approximately US\$246,4), maternal and paternal education (in years of formal study) and history of dental trauma. School attendance was categorized based on the cutoff point of 8 years, which corresponds to the level of primary education in Brazil.

Oral examination of children was performed in classrooms at preschools in which the child was enrolled by a single examiner previously trained and calibrated, with artificial lighting (Pelicano® table lamp - Startec with 127V, São Paulo, Brazil), in a simplified position with the child's head on the examiner's legs. Sterile gauze were used for the drying of the teeth and the examinations were performed using a sterilized mouth mirror (Golgran Ind. Com. Instr. Odontológicos, São Caetano do Sul, SP, Brazil), a sterilized exploratory probe No. 5 (Golgran Ind. Com. Instr. Odontológicos, São Caetano do Sul, SP, Brazil) and a sterilized periodontal probe recommended by the WHO (Trinity Indústria e Comércio Ltda., São Paulo, Brazil). Prior to the examinations, the children's teeth were brushed with fluoride toothpaste.

Dental caries experience was evaluated and included as a possible confounding variable of the analysis. It was based on established clinical criteria, classified through the ceo-d index recommended by the World Health Organization (WHO) and categorized as yes or no.

The diagnosis of malocclusion was made according to the criteria previously proposed for primary dentitions [18]: (1) left/right canines relationships - Class I (superior deciduous canine cusp sits between the lower deciduous canine and the first lower molar), Class II (upper deciduous canine deciduous cusp on the distal surface of the lower deciduous canine) or Class III (superior deciduous canine cusp distal to the distal surface of the lower deciduous canine) (2) overbite - normal (incisal surfaces of the lower deciduous central incisors in contact with the palatal surfaces of the upper central incisors when in centric occlusion); reduced (incisal surfaces of the lower deciduous central incisors not in contact with the palatal surfaces of the upper central incisors when in centric occlusion); open bite (incisal surfaces of the deciduous lower central incisors below the level of the incisal surfaces of the upper central incisors when in centric occlusion); or deep overbite (incisal surfaces of the deciduous lower central incisors touching the palate when in centric occlusion), (3) overjet, measured at the most protruding maxillary incisor - normal ($>0-2$ mm), increased (>2 mm), edge to edge (0 mm), anterior crossbite (<0 mm), and (4) posterior crossbite - present (maxillary teeth occlude lingually with the mandibular teeth) or absent. In this study, malocclusion was categorized as present (when at least one occlusal alteration was present) or absent (no abnormality).

Statistical Analysis

Data were analyzed using the Statistical Package for the Social Science, version 20.0 (IBM Corp., Armonk, NY, USA). The dependent variable was dichotomized for the presence or absence of malocclusion. The independent variables were socioeconomic and demographic aspects such as: sex, family income, maternal and paternal education and oral clinical aspects such as: dental caries experience and history of dental trauma. A descriptive analysis was performed to characterize the study participants. Poisson regression with robust variance was used to assess the associations between malocclusion, as a binary endpoint, and the independent variables. The magnitude of the association was determined by the crude and adjusted prevalence ratios (PR), with 95% confidence intervals (95% CI) and p values. The variables with $p \leq 0.20$ values in the bivariate analysis were included in the adjusted model. Only variables with a p-value <0.05 remained in the final model.

Ethical Aspects

This study was approved by the Research Ethics Committee of the Federal University of Piauí (Protocol No. 817.193) and conducted in accordance with Declaration of Helsinki. The parents/caregivers were clarified about the objectives of the study and signed a statement of free and informed consent. Also, the children answered an assent term.

Results

The final sample consisted of 566 children (94.0%) and their respective parents/caregivers. On the day of the clinical examination, 17 (2.8%) children were absent, 4 (0.7%) who had a diagnosis of autism spectrum disorder did not cooperate, and 15 (2.5%) were older than 5 years of age.

The prevalence of malocclusion was 51.2%. Male children with a family income of less than 2 minimum wages whose parents had more than 8 years of formal education formed the majority of the sample (Table 1).

Class II canines was the most frequent (17% and 16.8%) malocclusion, followed by increased overjet (15.2%) and reduced overbite (14%) (Table 2).

Table 1. Sample distribution, according to socioeconomic and clinical characteristics.

Variables	N (%)
Sex	
Male	301 (53.2)
Female	265 (46.8)
Family Income (Minimum Wages)	
≤ 2	382 (67.5)
> 2	184 (32.5)
Maternal Education	
≤ 8 Years	150 (26.5)
> 8 Years	416 (73.5)
Paternal Education	
≤ 8 Years	203 (35.9)
> 8 Years	363 (64.1)
Dental Caries Experience	
Yes	284 (50.2)
No	282 (49.8)
History of Dental Trauma	
Yes	95 (16.8)
No	471 (83.2)
Malocclusion	
Present	290 (51.2)
Absent	276 (48.8)
Total	566 (100.0)

Table 2. Occlusion characteristics of 5-year-old preschoolers.

Variables	N (%)
Right Canine Relationship	
Class I	419 (74.0)
Class II	96 (17.0)
Class III	51 (9.0)
Left Canine Relationship	
Class I	423 (74.7)
Class II	95 (16.8)
Class III	48 (8.5)
Overbite	
Normal	384 (67.8)
Reduced	79 (14.0)
Open Bite	31 (5.5)
Deep	72 (12.7)
Overjet	
Normal	435 (76.9)
Increased	86 (15.2)
Edge to edge	25 (4.4)
Anterior Crossbite	20 (3.5)
Posterior Crossbite	
Present	40 (7.1)
Absent	526 (92.9)
Total	566 (100.0)

In the bivariate regression, the presence of malocclusion was associated with a lower family income (PR = 1.22; 95% CI = 1.01-1.47) (Table 3).

Table 3. Poisson regression for the independent variables and malocclusion in preschool children.

Variables	Malocclusion		Crude		Adjusted	
	Present N (%)	Absent N (%)	PR (95% CI)	p-value	PR (95% CI)	p-value
Sex						
Male	157 (52.2)	144 (47.8)	1.04 (0.88–1.22)	0.640		
Female	133 (50.2)	132 (49.8)	1			
Family Income (Minimum Wages)						
≤ 2	208 (54.5)	174 (45.5)	1.22 (1.02–1.47)	0.034	1.22 (1.01–1.47)	0.035
> 2	82 (44.6)	102 (55.4)	1		1	
Maternal Education						
≤ 8 years	84 (56.0)	66 (44.0)	1.13 (0.95–1.34)	0.161		
> 8 years	206 (49.5)	210 (50.5)	1			
Paternal Education						
≤ 8 Years	104 (51.2)	99 (48.8)	1.00 (0.85–1.18)	0.999		
> 8 Years	186 (51.2)	177 (48.8)	1			
Dental Caries Experience						
Yes	147 (51.8)	137 (48.2)	1.02 (0.87–1.20)	0.802		
No	143 (50.7)	139 (49.3)	1			
History of Dental Trauma						
Yes	55 (57.9)	40 (42.1)	1.16 (0.96–1.41)	0.133	1.16 (0.95–1.40)	0.138
No	235 (49.9)	236 (50.1)	1		1	

Discussion

In the present study, the presence of malocclusion was observed in 51.2% of the preschool children, similar to a previous study that indicated a prevalence of 46.2% in children from Belo Horizonte/MG [6]. Other studies reported higher values, such as 62.4% in Campina Grande/PB [1], 66.7% in the Brazilian population [5] and 81.44% in Belém/PA [8].

Comparison of studies evaluating malocclusion in primary dentition is complicated due to the variety of diagnostic criteria and nomenclatures used [6]. In the present study, the Foster & Hamilton Index [18] was performed because it was recommended by other epidemiological studies [1,5,6,9,11,19]. In addition, several studies have established different ages as inclusion criteria, ranging between 2 and 6 years of age [1,6-9,11,19], whereas in this study, the age of 5 years was selected for comparative purposes, as recommended by the World Health Organization [20]. This age group was also selected because it was used in the most recent Brazilian National Oral Health Survey (SBrasil Project) [5].

Longitudinal studies observed that the presence of malocclusion in the primary dentition is a risk factor for the need of orthodontic treatment in the permanent dentition, especially for cases involving Class II canines, anterior open bite, and posterior crossbite in the primary dentition [9-11]. In this context, it is important to conduct orthodontic examinations in preschoolers so that malocclusions are diagnosed early, and etiological factors identified and removed as early as possible, in order to prevent the occurrence of more severe malocclusions in the permanent dentition [9].

Class II canines and increased overjet were the most frequent malocclusions observed in this study, corroborating the findings presented by other authors [1,8]. In addition to the genetic inherit, this malocclusion is more frequent in preschool children with pacifier sucking habit [21]. Treatment of this condition can be performed in one phase (permanent dentition only) or in two phases (mixed and permanent dentitions). There are no differences in the outcome of treatment independent of the phase in which it begins,

although mixed-dentition treatments reduce the incidence of dental trauma in incisors and improves children's self-esteem [15].

The reduced overbite was the third most frequent type of malocclusion, whereas anterior open bite was one of the conditions with a lower prevalence. However, other studies consider the latter type to be one of the most prevalent types of malocclusion in the preschool age group [1,5,11]. This discrepancy may be related to the age of the children evaluated (5 years) in this study since there is a proven reduction in the prevalence of sucking habits from 3 to 5 years of age because most children present spontaneous interruption behaviors (without therapeutic intervention) [22]. In addition, the occurrence of these habits may vary among populations, as they are influenced by cultural and socioeconomic differences [1,23,24].

The etiology of open bite is usually multifactorial and may be caused by growth discrepancies, alterations in the neuromuscular function of the tongue and non-nutritive sucking habits [14]. This malocclusion can be self-corrected and have a good response to interceptive orthodontic treatments. However, they are challenging when present a skeletal etiology and some cases tend to recur [25]. The early orthodontic intervention of this condition during the primary or mixed dentition phases has been supported due to the functional and esthetic benefits. Furthermore, it decreases the need for more complex treatment in the permanent dentition, although there is insufficient evidence regarding which type of treatment is more stable [25,26].

Anterior crossbite was the least frequent type of occlusion in this study, corroborating the results found in the epidemiological survey SB Brasil [5]. The etiology of this malocclusion is also multifactorial and can occur due to hereditary growth or environmental factors such as early dental loss, presence of supernumerary teeth and parafunctional habits. It can be classified as functional, dental or skeletal, with the first type being the most frequent in the primary dentition [27]. Despite the low prevalence found in previous studies, early treatment of this malocclusion should be considered first, since uncrossing of the bite allows a more harmonious growth of the bone bases, thus reducing the severity of the changes in the permanent dentition [27-29].

Genetic factors, deleterious oral habits and dental caries experience have been emphasized as the main determinants of malocclusion [11,30]. In the present study, history of dental caries did not show to be associated with a higher prevalence of malocclusion. There was also no association with a history of dental trauma, sex or age. A previous representative study for the Brazilian population found an association between malocclusion and gender, with a higher prevalence among female children [13].

Children belonging to families who reported a family income of less than two minimum wages presented a 22% higher prevalence of malocclusion, diverging from other studies that did not observe a statistically significant association between socioeconomic status and the presence of malocclusion [1,6,9,11]. Family income is a characteristic that may be related to access to dental services and may influence the behavior of the population, such as eating and deleterious oral habits [13]. Previous study showed that there is a higher risk of developing a Class II canine relationship, posterior crossbite and anterior open bite among children with primary dentition who have a history of poor breastfeeding [30]. In addition, the use of pacifiers and digital suction are associated with varied risks of malocclusion development, such as increased overjet, Class II canine relationship and posterior crossbite [31].

Since the etiology of malocclusion is multifactorial and has a strong genetic component, the effect of associated factors, such as family income, would have a limited benefit in cases in which the characteristics of a

patient's malocclusion are mainly genetic [31]. Thus, the relationship between socioeconomic factors and dental conditions is not well established in the literature further studies are needed to confirm these findings.








In view of the possibility of preventive action in the etiology of some malocclusions, prevention of malocclusions should be prioritized in public health policies to avoid possible damage to the permanent dentition, especially in low-income populations [13]. In addition, the financial cost for the prevention of malocclusion in the primary/mixed dentition is lower than in the permanent dentition [1].

The present study presents the inherent limitations of cross-sectional studies, so that cannot be considered a cause-and-effect relationship.

Conclusion

The prevalence of malocclusion in the primary dentition was high and associated with a low family income.

Authors' Contributions

JIAM	 0000-0003-3122-4827	Conceptualization, Data Curation, Writing – Original Draft Preparation and Visualization.
NSA	 0000-0001-5945-8401	Conceptualization, Methodology, Formal Analysis, Investigation and Writing – Original Draft Preparation.
RNCS	 0000-0001-9119-7045	Investigation and Writing – Original Draft Preparation.
MVNR	 0000-0002-9575-4352	Writing – Review and Editing and Visualization.
LFDM	 0000-0002-4112-1533	Writing – Review and Editing and Visualization.
WLM	 0000-0003-3754-9980	Writing – Review and Editing and Visualization.
MDML	 0000-0002-7641-6331	Conceptualization, Methodology, Writing – Original Draft Preparation, Writing – Review and Editing, Visualization and Project administration.

All authors declare that they contributed to critical review of intellectual content and approval of the final version to be published.

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Conflict of Interest

The authors declare no conflicts of interest.

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