

Assessment of occlusal characteristics of the primary dentition: a cross-sectional study in Brazilian preschool children

Avaliação das características oclusais da dentição decídua: um estudo transversal em pré-escolares brasileiros

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Abstract

Objective: The present study aimed to determine the occlusal characteristics and prevalence of malocclusion among Brazilian preschool children. **Subjects and method:** A cross-sectional study was conducted with 1004 children aged 2-5 years enrolled in public preschools of the city of Canoas, RS, Brazil. A questionnaire was administered to guardians addressing demographic, socioeconomic, and behavioral characteristics of the children and their families. The clinical exam was performed by previously calibrated dentists and the characteristics of the primary dentition were verified according to set criteria. Data analysis was performed through the chi-square test. **Results:** Stability in the sagittal and transverse planes of the posterior region, and a variability of incisal relations in the primary dentition were verified. The findings show high prevalence of malocclusion (70.3%) and its association with age. **Conclusion:** Considering the high prevalence of malocclusion in primary dentition, implementing educational programs and prevention measures for preschool children is highlighted.

Keywords: Dental occlusion. Epidemiology. Malocclusion. Prevalence. Tooth deciduous.

Introduction

The development of occlusion depends on the harmonic growth of the maxilla and mandible, and the role of the functional matrix, which correlates form and function¹. In the primary dentition, however, occlusal relation has been underexplored².

The characteristics of the anterior region in primary dentition are classified by space discrepancies (type of arch) and incisal relation (overjet and anterior open bite) and the posterior region is identified by sagittal deviations (molar and canine relation) and transverse deviations (posterior crossbite). Studies performed in the last 60 years report the most common features that may predict the favorable development of the permanent dentition³, including the presence of diastemas in the anterior region, non-increased overjet and overbite, straight or mesial step of primary molars, and Class I canine relation⁴⁻⁸. Chart 1 shows some of the occlusal characteristics of the primary dentition described in Brazilian studies published since the year 2000.

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Chart 1 – Occlusal characteristics of primary dentition described in Brazilian studies

Author/Year	Location	Subjects		Primary Dentition	
		N	Age (Years)	Anterior	Posterior
Ferreira et al. ⁹ (2001)	Salvador, BA	356	3-5	<i>Space Discrepancies</i> Arch type II - 55%	<i>Sagittal Deviations</i> Mesial step - 55%; Straight - 38%; Cl I canine - 62%
López et al. ⁵ (2001)	Porto Alegre, RS	567	3-5	<i>Space Discrepancies</i> Arch type I - 73% <i>Incisal Relation</i> Anterior open bite - 39%	<i>Sagittal Deviations</i> Straight - 64%; Distal step - 19% <i>Transverse Deviations</i> Posterior crossbite - 17%
Kataoka et al. ¹⁰ (2006)	São Paulo, SP	310	2-6	<i>Incisal Relation</i> Increased overjet - 14%	<i>Sagittal Deviations</i> Mesial step - 47%; Straight - 41%; Cl I canine - 77%
Raupp et al. ⁷ (2008)	Canoas, RS	923	3-5	<i>Space Discrepancies</i> Arch type II - 57%	<i>Sagittal Deviations</i> Straight - 38%; Mesial step - 36%; Cl I canine - 59%
Cândido et al. ⁸ (2010)	João Pessoa, PB	350	2-5	<i>Space Discrepancies</i> Arch type I - 75% <i>Incisal Relation</i> Anterior open bite - 70%	<i>Sagittal Deviations</i> Mesial step - 56%; Straight - 31% <i>Transverse Deviations</i> Posterior crossbite - 8%
Brasil ¹¹ (2010)	Brazil	7045	5	<i>Incisal Relation</i> Increased overjet - 22% Anterior open bite - 12%	<i>Sagittal Deviations</i> Cl I canine - 77% <i>Transverse Deviations</i> Posterior crossbite - 2%
Jabbar et al. ¹² (2011)	São Paulo, SP	911	3-6	<i>Incisal Relation</i> Increased overjet - 40%	<i>Sagittal Deviations</i> Cl I canine - 59%

Source: authors' elaboration.

It is generally agreed that the occlusion of primary dentition plays a role in determining the occlusion in corresponding permanent dentition^{2,3}. A great number of studies report the prevalence of malocclusion in different populations, with rates ranging from 34% to 67%^{11,13,14}. The criteria employed for determining malocclusion is likely the most important factor explaining these differences. Chart 2 displays the results of Brazilian studies published

since the year 2000. Although occlusal features of the primary dentition have been described in the literature from the investigations performed by Baume in the 1950s, few population-based studies have performed separate analyses of anterior and posterior regions. The present study aimed to determine occlusal characteristics and prevalence of malocclusion of public preschool children aged two to five years in the city of Canoas, southern Brazil.

Chart 2 – Prevalence of malocclusion in primary dentition described in Brazilian studies

Author/Year	Location	Subject		Malocclusion	Prevalence (%)
		N	Age (years)		
Brasil ¹⁵ (2003)	Brazil	4678	5	WHO*	36
Cândido et al. ⁸ (2010)	João Pessoa, PB	350	2-5	WHO*	44
Brasil ¹¹ (2010)	Brazil	7045	5	Foster, Hamilton**	67
Granville-Garcia et al. ¹⁴ (2010)	Recife, PE	2651	1-5	Foster, Hamilton	34
Carvalho et al. ¹⁶ (2011)	Belo Horizonte -MG	1069	5	Foster, Hamilton	46

*WHO: mild or moderate/severe occlusal disorders.

** Foster, Hamilton: increased overjet, anterior open bite, or posterior crossbite.

Source: authors' elaboration.

Subjects and method

Subjects and study design: a cross-sectional study was conducted involving preschool children in the city of Canoas (Southern Brazil), which has a population of approximately 324,000 inhabitants and all households have access to fluoridated public water supply (fluoride level: 0.8 ppm). An oral health census was performed from June to December 2010. The study population included all 1380 children aged two to five years enrolled at public preschools and their parents/guardians. Exclusion criteria were the presence of one or more erupted permanent teeth, ongoing or previous orthodontic treatment, and the absence of any primary teeth.

Data collection: six teams consisting of an examiner (dentist, MSc student) and an auxiliary (undergraduate student) performed the fieldwork. Data were collected at preschools by means of a clinical oral examination of children and structured interviews with guardians.

Demographic and socioeconomic questionnaire: A questionnaire was administered to guardians addressing children's gender (male/female), age (2, 3, 4, and 5 years), mother's level of education (categorized as <9 years, 9 to 11 years, and >11 years), and family income (categorized as <1 BMW, 1 to 3 BMW, and >3 BMW). The Brazilian minimum wage was approximately US\$ 300 at the time of data collection.

Clinical examination: Children were examined in a preschool classroom, lying on ordinary desks under natural light. Teeth were cleaned and dried with gauze. The clinical examination was exclusively visual and performed with the aid of a dental mirror, tongue depressor, and a millimeter ruler. Biosafety measures established by the WHO were strictly followed¹⁷.

The characteristics assessed in the anterior region were space availability (type of arch) and incisal relation (overjet and anterior open bite), and those evaluated in the posterior region were sagittal deviations (molar and canine relation) and transverse deviations (posterior crossbite). The occlusal characteristics of primary dentition were described using the following standard and previously published definitions^{6,18}:

- *Type of arch*: measured as contact between teeth and categorized as lack of contact between adjacent teeth (type I) or imbrications (overlapping of adjacent teeth; type II).
- *Incisal overjet*: measured as the distance between the palatal surface of the most protruded maxillary incisor and the labial surface of the corresponding mandibular incisor, and categorized as normal (≤ 2 mm) or increased (>2 mm).
- *Anterior open bite*: based on the vertical relation between upper and lower central incisors, defined as the absence of vertical

overlap of lower incisors, and categorized based on presence/absence.

- *Terminal plane of primary molars*: class I or straight - distal surface of upper and lower second primary molars on the same vertical plane in centric occlusion; class II or distal step - distal aspect of the lower second primary molar in posterior relation to that of the upper second primary molar in centric occlusion; and class III or mesial step - distal face of lower second primary molar in anterior relation to that of the upper second primary molar in centric occlusion.
- *Canine relation*: class I - tip of the upper primary canine on the same vertical plane as the distal aspect of the lower primary canine in centric occlusion; classes II and III - tips of upper primary canines in anterior and posterior relation to the distal aspect of lower primary canine in centric occlusion, respectively.
- *Posterior crossbite*: upper primary molars occluded in lingual relation to lower primary molars and categorized as presence/absence.
- *Malocclusion*: recorded when the child presented at least one of the following characteristics - increased overjet, anterior open bite, or posterior crossbite.

Intra-examiner and inter-examiner reliability were measured using kappa statistics. Inter-examiner reliability ranged from 0.84 (95% CI: 0.64-1.00) to 1.00, and intra-examiner reliability ranged from 0.79 (95% CI: 0.60-0.98) to 1.00.

Data analysis: statistical analysis was performed using the Statistical Package for Social Sciences (version 16.0, SPSS Inc., Chicago, IL, USA). The chi-square test was used to investigate whether there were differences in occlusal characteristics and malocclusion in different age groups.

Ethical considerations: this study was approved by the human research ethics committee of Universidade Luterana do Brasil (ULBRA). The participants' rights were protected. The guardians read and signed an informed consent form prior to participation. Children with dental problems were referred to the School of Dentistry of ULBRA, where treatment was ensured.

Results

Participation rate was 90.2% (1245/1380). Losses occurred due to repeated absences of the child on the day of the examination ($n = 69$), failure to bring the informed consent form signed by the parents ($n = 28$), impossibility of contacting guardians for the interview ($n = 21$), and child's refusal during clinical examination ($n = 17$). Moreover, data on 241 participants were excluded from the final analysis because of the presence of erupted permanent teeth ($n = 197$), ongoing orthodontic treatment ($n = 12$), and absence of primary teeth ($n = 32$). Thus, the final sample comprised 1004 children.

Table 1 presents sample characteristics. Mean age was 3.5 years ($SD = 1.0$), and maternal level of education varied from 0 to 16 years; 54.1% of mothers had between 9 and 11 years of education. Household income was low, with 83.2% of families earning less than three times the monthly Brazilian minimum wage (approximately US\$ 900).

Table 1 – Characteristics of the sample of children (n = 1004). Canoas/Brazil, 2010

Variables	N	%
Gender		
Male	526	(52.4)
Female	478	(47.6)
Age (years)		
2	193	(19.2)
3	294	(29.3)
4	319	(31.8)
5	198	(19.7)
Mother's education (years)		
< 9	356	(36.6)
9 – 11	526	(54.0)
> 11	91	(9.4)
Family income		
< 1 BMW*	126	(13.6)
1 - 3 BMW	644	(69.6)
> 3 BMW	155	(16.8)

*BMW: Brazilian minimum wage

Source: authors' elaboration.

Table 2 – Occlusal characteristics of primary dentition related to chronological age. Canoas, Brazil, 2010

Occlusal characteristics	2 years		3 years		4 years		5 years		All (2-5 years)		p*
	N	%	N	%	N	%	N	%	N	%	
Anterior region											
Space discrepancies											
Type of arch											
Type I	85	(44.3)	118	(40.3)	106	(33.3)	79	(40.5)	388	(38.9)	0.166
Type II	107	(55.7)	175	(59.7)	212	(66.7)	116	(59.5)	610	(61.1)	
Incisal relation											
Increased overjet											
Yes	143	(74.1)	181	(61.6)	188	(58.9)	101	(51.0)	613	(61.1)	0.000
No	50	(25.9)	113	(38.4)	131	(41.1)	97	(49.0)	391	(38.9)	
Anterior open bite											
Yes	108	(56.0)	152	(51.7)	114	(35.7)	52	(26.3)	426	(42.4)	0.000
No	85	(44.0)	142	(48.3)	205	(64.3)	146	(73.7)	578	(57.6)	
Posterior region											
Sagittal Deviations											
Molar relation											
Straight terminal plane	48	(38.4)	126	(43.2)	128	(40.3)	71	(36.8)	373	(40.2)	0.766
Mesial step	50	(40.0)	112	(38.4)	123	(38.7)	74	(38.3)	196	(38.7)	
Distal step	27	(21.6)	54	(18.5)	67	(21)	48	(24.9)	359	(21.1)	0.160
Canine relation											
Class I	99	(52.4)	144	(49.1)	191	(60)	116	(58.6)	550	(55.1)	
Class II	78	(41.3)	124	(42.3)	101	(31.8)	65	(32.8)	368	(36.9)	
Class III	12	(6.3)	25	(8.5)	26	(8.2)	17	(8.6)	80	(8.0)	
Transverse Deviations											
Posterior Crossbite											
Yes	14	(7.30)	41	(13.9)	41	(12.9)	23	(11.6)	119	(11.9)	0.284
No	719	(92.7)	253	(86.1)	278	(87.1)	175	(88.4)	885	(88.1)	
Malocclusion											
Yes	155	(80.3)	218	(74.1)	214	(67.1)	119	(60.1)	706	(70.3)	0.000
No	38	(19.7)	76	(25.9)	105	(32.9)	79	(39.9)	298	(29.7)	

* Chi-square test for linear trend

Source: authors' elaboration.

Table 2 shows the occlusal characteristics of the sample. A total of 61.1% of children had imprecisions in the anterior region. No significant association was found between age and the frequency of spacing and crowding in the anterior region ($p = 0.166$). Regarding incisal relation, most children (61.1%) had increased overjet (>2 mm), and anterior open bite was found in 426 children (42.4%). Age was associated with both conditions, and there was a significant reduction in the prevalence of increased overjet; also, anterior open bite occurred with the increase in age ($p < 0.01$). For molar relation, a straight terminal plane was found in 40.2% of children, whereas distal and mesial steps were found in 21.1% and 38.7%, respectively. For canine relation, 550 children (55.1%) had Class I relation, 368 (36.9%) had Class II relation, and 80 (8%) had Class III relation. No significant associations were found between age and molar ($p = 0.766$) or canine ($p = 0.160$) relation. Regarding transverse deviations, posterior crossbite was found in 11.9% of children and was not significantly associated with age ($p = 0.284$). The prevalence of malocclusion in primary dentition was 70.3%. A total of 706 children showed anterior open bite, increased overjet, or posterior crossbite. Furthermore, malocclusion varied through the different dental development periods ($p < 0.01$), and there was a significant reduction in prevalence with the increase in age.

Discussion

The frequently used term "normal occlusion" may hardly be applied to the wide variety of conditions that seem to exist in primary dentition. Moreover, some authors believe that primary dentition remains unchanged in preschool children⁴. Thus, studies are required to address these assumptions, and new data are required for a full understanding of this biogenetic course^{2,19}.

The main findings of the present study highlight four important issues concerning the development of primary dentition: (1) stability of arches on sagittal and transverse planes in the posterior region, (2) variability in incisal relation; (3) high prevalence of malocclusion, and (4) the association between malocclusion and age. Moreover, this investigation has particular characteristics that should be noted. The study design was appropriate for the identification of individuals with and without malocclusion. The sample size of 1004 participants provides the study with the precision that has often been lacking in many previously conducted studies in this field, which leads to greater potential of meeting the proposed objectives.

Occlusal relation and their significance to the development of primary and permanent dentition may be assessed by focusing on different features, depending on the dental arch region involved - anterior or posterior. In the present study, the posterior region was characterized by the stability of dental arches on sagittal and transverse planes between the ages of two and five years. The literature available also suggests that these characteristics persist into the mixed dentition phase²⁰⁻²². The anteroposterior relation herein observed indicates a prevalence (80%) of straight terminal relation or mesial step for molars, and Class I canine relation was found in more than 50% of the sample. Such features contribute to the favorable development of mixed and permanent dentitions^{2,3,7,8,9-12}.

Posterior crossbite is characterized by a transverse interarch discrepancy in response to a reduction in transverse dimension of the maxillary arch²⁰. In the present study, transverse deviations were found in 11.9% of children. The incidence of constriction of the maxillary arch in primary dentition has an etiological relation to frequent sucking habits (either thumb or dummy sucking) in this development stage, associated or not with respiratory problems. Crossbite requires immediate treatment because it is not self-correcting and creates skeletal changes that make later correction difficult^{22,23}.

The anterior region should be analyzed separately based on space availability and incisal relation. The findings of the present study indicate a prevalence of type II arch in nearly 2/3 of children. The absence of spacing in maxillary labial segment constitutes a risk factor for dental caries

in preschool children^{24,25} and is unfavorable to the proper alignment of permanent dentition²⁶.

Incisal relation may show significant changes in primary dentition. Increased overjet (>2 mm) and anterior open bite were found in 61.1% and 42.4% of the children examined, respectively. Increased overjet has been identified as a risk factor for traumatic dental injury, and anterior open bite is considered the malocclusion with the highest esthetic and functional impact in childhood²⁷⁻²⁹. Moreover, sucking habits have been indicated as an etiological factor for increased overjet and anterior open bite³⁰⁻³⁴.

The literature reports a tendency toward the spontaneous correction of abnormalities in incisal relation of primary dentition^{4,8}. In the present study, the distribution of increased overjet was 74.1% in two-year-olds and 51% in five-year-olds (linear decrease with age). Open bite from sucking habits usually self-corrects after removing the habit. However, there is cause for concern, as a more severe degree of malocclusion established in the early stages of occlusal development may not self-correct with normal growth and development²⁰.

In contrast, the present findings show that the stability of occlusal relation in primary dentition may only be associated with the sagittal and transverse planes in the posterior region. In the anterior region, there is a tendency toward self-correction of the abnormal incisal relation, especially anterior open bite. Nonetheless, the prevalence of malocclusion at five years of age is high (70.3%). A recent Brazilian national epidemiological survey reports similar findings to those of the present study, with prevalence rate of 66.7% using the same index¹¹.

A balanced occlusion in primary dentition favors the proper development of chewing, speech, and breathing functions in a critical period of both physical and emotional growth and development³². Psychological conditions related to esthetic problems and the prevention of upper incisor fractures from trauma may influence the decision in favor of an earlier intervention²⁷.

Thus, as breastfeeding and non-nutritive sucking habits are associated and showed opposite effects on the prediction of malocclusions^{12,21,31}, implementing educational programs and prevention measures in early childhood is essential to reduce the prevalence of malocclusion among preschoolers. Considering that the positive influence of breastfeeding may be masked by the effect of exposure to persistent non-nutritive sucking habits, it is suggested that further studies are planned with a longitudinal design, including a larger sample size.

Conclusions

The findings of the present study indicate stability in the posterior region and considerable variability in the incisal relation of primary

dentition. Moreover, the prevalence of malocclusion was high, with higher prevalence rate among younger children. Thus, despite the methodological limitations, this study represents a valid contribution to promoting educational programs and prevention measures in early childhood to reduce or even eliminate etiological factors related to malocclusion.

Resumo

Objetivo: este trabalho teve como objetivo determinar as características oclusais e a prevalência de oclusopatias em pré-escolares brasileiros. *Sujeitos e método:* foi realizado um estudo transversal em 1.004 crianças, de 2 a 5 anos de idade, matriculadas nas escolas de educação infantil do município de Canoas, RS. Um questionário foi aplicado aos responsáveis com questões demográficas, socioeconômicas e comportamentais sobre as crianças e suas famílias. O exame clínico foi realizado por dentistas previamente calibrados e as características da dentição decídua foram verificadas de acordo com critérios estabelecidos. A análise dos dados foi realizada por meio do teste Qui-Quadrado. *Resultados:* verificou-se uma estabilidade no plano sagital e transversal na região posterior e uma variabilidade nas relações incisais na dentição decídua. Os achados demonstraram uma alta prevalência de oclusopatias (70,3%) e constatou-se associação com a idade. *Conclusão:* devido à alta prevalência de oclusopatias na dentição decídua, destaca-se a importância da implementação de programas educativos e preventivos em pré-escolares.

Palavras-chave: Oclusão dentária. Epidemiologia. Má oclusão. Prevalência. Dente decíduo.

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