

Factors Associated with the Occurrence of Distocclusion in the Primary Dentition: A Hierarchical Analysis

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Objective: The aim of the present study was to identify factors associated with the occurrence of distocclusion among preschool children in southern Brazil. **Study Design:** A cross-sectional study was carried out with a sample of 1026 children aged two to five years enrolled at public preschools in the city of Canoas, Southern Brazil. Interviews were held with parents/caregivers to acquire demographic, socioeconomic and behavioral data. Six examiners who had undergone a training and calibration exercise performed the oral examinations. Distocclusion was recorded when the cusp of the maxillary canine was in an anterior relation to the distal surface of the mandibular canine during centric occlusion. Statistical analysis involved simple and multivariate Poisson regression with robust variance. **Results:** The prevalence of distocclusion was 36.5% (375/1026). This condition was more frequent in younger children, those classified as white or brown, those who were breastfed for a shorter period of time, those who used a pacifier and those who were bottle fed. The multivariate analysis demonstrated that the likelihood of exhibiting distocclusion was greater among two-year-olds ($P=0.038$), three-year-olds ($P=0.023$), those classified as white ($P=0.016$), those who used a pacifier ($P<0.001$) and those who used to use a pacifier ($P<0.001$). **Conclusion:** Counseling with regard to the duration of pacifier use could contribute toward reducing the prevalence of distocclusion and its consequences in preschool children.

Key words: oral health, children, malocclusion, epidemiology

INTRODUCTION

Distocclusion is characterized by a more posterior position of the mandible in relation to the maxilla on the sagittal plane.¹ In the primary dentition, the prevalence rate of distocclusion ranges from 14.2 to 52.4%.¹⁻⁴ Functional alterations, esthetic problems and an increased risk of traumatic dental injuries are among the possible consequences of this condition.⁵⁻¹⁰ Moreover, longitudinal studies have shown that a discrepancy of at least 1 mm in the distal relation of the canines in the primary dentition can determine a Class II relation in the permanent dentition.¹¹⁻¹³

To establish prevention strategies for distocclusion, it is essential to recognize its network of causality. The anteroposterior relationship between the primary dental arches is predominantly conditioned by genetic factors.¹⁴ However, some studies have suggested that behavioral factors, such as nonnutritive sucking habit (prolonged use of a pacifier or bottle feeding) and feeding habits (breastfeeding) may also exert an impact on craniofacial growth and development.^{1,15-16} This may be explained by the inducing potential of the neuromuscular system on the growth of craniofacial structures and the development of occlusion.⁵ Moreover, it is possible that socio-demographic characteristics exert an influence on the occurrence of this outcome.¹⁷ However, few studies have performed a concomitant investigation into the effect of demographic and behavioral variables regarding the occurrence of distocclusion and fewer still have employed multivariate analysis. Knowledge of these effects could indicate possible preventive measures that could minimize the consequences in adulthood.

The aim of the present study was to identify demographic, socioeconomic and behavioral factors associated with the occurrence of distocclusion in the primary dentition.

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MATERIALS AND METHOD

The present cross-sectional study is part of an oral health survey conducted in the city of Canoas in southern Brazil between 2010 and 2011 for the determination of different oral health outcomes and oral health-related quality of life. The city has a population of approximately 324,000 inhabitants and all households have access to the fluoridated public water supply (F level: 0.8 ppm) (Rio Grande do Sul, Brazil – Health Surveillance – Water Supply Quality Control). The outcome in the present study was distocclusion in the primary dentition. The sample consisted of 1036 children aged two to five years enrolled in public preschools in Canoas. The exclusion criteria were one or more permanent teeth erupted, absence of one or more canines and a history of orthodontic treatment.

Prior to the study, six dentists had undergone training and calibration exercises involving a sample of 40 children aged two to five years. Unweighted Kappa coefficients were calculated for the determination of intra-examiner and inter-examiner reliability regarding the diagnosis of malocclusion (accentuated overjet, anterior open bite and posterior crossbite) in two exams with a 10-day interval between exams. Inter-examiner agreement ranged from 0.84 [95% confidence interval (CI): 0.64-1.00] to 1.00 and intra-examiner agreement ranged from 0.79 (95% CI: 0.60-0.98) to 1.00.

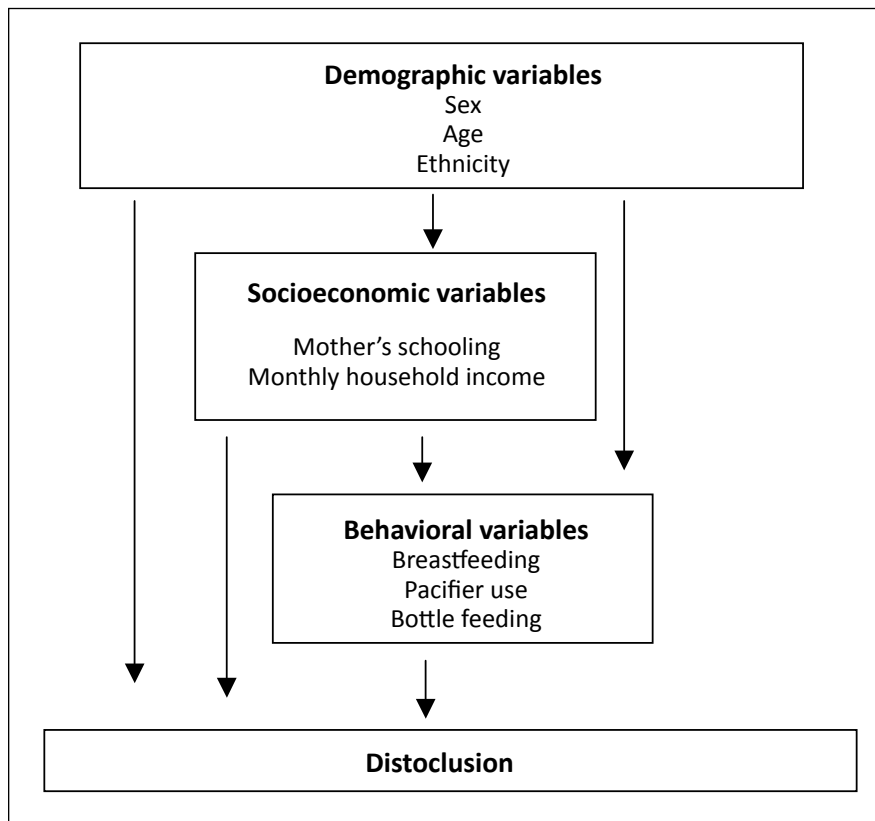
A questionnaire was developed to gather information on demographic characteristics [child’s sex, age (in years completed) and ethnicity – white, black and brown], socioeconomic characteristics [mother’s schooling (complete years of study), family structure

(nuclear – child live with both parents; non-nuclear – any other arrangement) and monthly household income (in R\$ - Brazilian currency)] and behavioral characteristics [use of pacifier or bottle (never used, stopped using or continues to use) and total duration of breastfeeding (in months)].

The clinical exam was performed with the aid of a mouth mirror and millimeter ruler, with the child in the lying position in a classroom at the respective preschools. The teeth were first brushed and dried with gauze. The criterion proposed by Foster and Hamilton¹⁸ was used for the determination of distocclusion: when the cusp at least one maxillary canine was in an anterior relation to the distal surface of the mandibular canine during centric occlusion.

The SPSS version 17.0 was used for the statistical analyses. Absolute and percentage frequencies were described for the exposure variables and outcome. The chi-square test and both simple and multivariate Poisson regression with robust variance were conducted to identify factors associated with the occurrence of distocclusion. Crude prevalence ratios (PR) were calculated for all the independent variables. The multivariate model followed a hierarchical approach on three levels (Figure 1): 1) demographic variables (child’s sex, age and ethnicity); 2) socioeconomic variables (mother’s schooling and household income); and 3) behavioral variables (breastfeeding, use of pacifier and bottle feeding). The backward stepwise procedure was used to select the variables on each level, with the one-by-one elimination of variables with a p-value greater than 0.20. In the final model, the PR was estimated for the variables on the same or higher level that remained in the multivariate model. Independent variables

Figure 1 – Hierarchical conceptual model for occurrence of canine distocclusion in primary dentition



with a p-value < 0.05 in the multivariate model were maintained in the final regression model.

This study received approval from the Human Research Ethics Committee of the Lutheran University of Brazil and was conducted in accordance with Resolution 196/96 of the Brazilian National Board of Health (Protocol number 2010-056H). Parents/legal guardians received clarifications regarding the objectives and procedures and signed a statement of informed consent agreeing to the participation of the children.

RESULTS

The participation rate was 94.6% and the final sample was comprised of 1026 children aged two to five years. The sexes were distributed similarly (males: 52%; females: 48%). Age was distributed as follows: 5 years – 19.8%; 4 years – 32%; 3 years – 28.9% and 2 years – 19.3%. Regarding ethnicity, most subjects were white (66.8%), 18% were brown and 15.2% were black. Mother’s schooling ranged from 0 to 16 years of study (mean: 7.5 ± 3.3 years). Approximately two thirds of the families earned two times the Brazilian monthly minimum wage or less (Table 1).

The prevalence of distocclusion was 36.5% (375/1026). This condition was significantly more frequent in younger children (p = 0.003), those classified as white or brown (p = 0.040), those who were breastfed for a shorter period of time and who used a pacifier and bottle (p < 0.001). The same variables were associated to the outcome in the crude model (Table 2).

After the adjustments, the multivariate analysis demonstrated that the likelihood of exhibiting distocclusion was greater among two-year-olds (PR: 1.31; 95% CI: 1.02-1.70), three-year-olds (PR: 1.32; 95% CI: 1.04-1.68), those classified as white (PR: 1.39; 95% CI: 1.06-1.83) in comparison to those classified as black, those who used a pacifier (PR: 3.04; 95% CI: 2.34-3.95) or used to use a pacifier (PR: 2.13; 95% CI: 1.57-2.89) in comparison to those who never used a pacifier. Bottle feeding and duration of breastfeeding lost their statistical significance after the multivariate adjustment.

In an additional analysis, all variables were incorporated into the multivariable model regardless of their p-values. Age lost its significance after adjusting for pacifier use, indicating that pacifier use is the path by which age acts on distocclusion.

DISCUSSION

The occurrence of different types of malocclusion in children and adolescents has been mainly associated with genetically inherited characteristics, which hinders early prevention and control. In the present study, the association between distocclusion and factors on different hierarchical levels was investigated. The main finding was the strong association between pacifier use and the outcome.

Although the cross-sectional design does not allow the establishment of cause and effect relationships, some of the characteristics and findings of the present study suggest causality. Firstly, the habit of pacifier use is generally established in the first months of life ¹⁹ whereas the canine relation is only established after the first year. It is therefore plausible that the exposure preceded the outcome. Secondly, the strong association encountered demonstrates with a reasonable degree of precision that the likelihood of exhibiting distocclusion was threefold higher among children who used a pacifier. Thirdly, the findings indicate a dose-response effect,

Table 1 – Prevalence of distocclusion according to independent variables

Variables	N	(%)	Distocclusion		p*
			N	(%)	
Sex					0.066
Male	534	(52.0)	181	(33.9)	
Female	492	(48.0)	194	(39.4)	
Age					0.003
2 years	198	(19.3)	83	(41.9)	
3 years	297	(28.9)	125	(42.1)	
4 years	328	(32.0)	102	(31.1)	
5 years	203	(19.8)	65	(32.0)	
Ethnicity					0.040
White	685	(66.8)	262	(38.2)	
Brown	185	(18.0)	70	(37.8)	
Black	156	(15.2)	43	(27.6)	
Mother’s schooling					0.565
< 9 years	366	(36.8)	129	(35.2)	
9 to 11 years	537	(54.0)	197	(36.7)	
> 11 years	92	(9.2)	35	(38.0)	
Household income					0.614
< 1.5 times monthly min. wage	344	(36.4)	120	(34.9)	
1.5 to 2 times monthly min. wage	278	(29.4)	105	(37.8)	
> 2 times monthly min. wage	324	(34.2)	119	(36.7)	
Breastfeeding duration					<0.001
< 6 months	386	(39.4)	166	(43.0)	
6 to 12 months	270	(27.6)	106	(39.3)	
> 12 months	323	(33.0)	85	(26.3)	
Pacifier use					<0.001
Never	329	(32.2)	54	(16.4)	
Used in past	223	(21.8)	77	(34.5)	
Continues using	470	(46.0)	243	(51.7)	
Bottle feeding					<0.001
Never	90	(8.8)	18	(20.0)	
Used in past	250	(24.6)	80	(32.0)	
Continues using	677	(66.6)	275	(40.6)	

* chi-square test

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as even children who had stopped using a pacifier had a twofold greater likelihood of exhibiting distocclusion. Moreover, the present findings are consistent with data reported for American children.²⁰⁻²¹

In the crude model, bottle feeding and the duration of exclusive breastfeeding were associated with the outcome. The fact that both variables lost statistical significance in the multivariate analysis suggests that the associations in the crude model were the result of the confounding effect of pacifier use. Thus, children who were breastfed for a shorter period of time or continued bottle feeding had

a greater likelihood of exhibiting distocclusion because they used a pacifier more. Moreover, in a cohort study conducted in the city of Porto Alegre (southern Brazil), a longer period of breastfeeding was associated with a lower prevalence rate of distocclusion in children aged three to five years.¹ Although apparently contradictory, these findings actually indicate an intricate relationship among pacifier use, breastfeeding and bottle feeding. Previous studies report a strong relationship between pacifier use and breastfeeding duration

Table 2 – Crude and adjusted prevalence ratios (RP) and 95% confidence intervals (CI) for the occurrence of distocclusion according to independent variables

Variable	Crude model			Multivariate model*		
	PR	95% CI	p	PR	95% CI	p
Level 1 – Demographic						
Sex			0.066			
Male	1.00			#		
Female	1.16	(0.99-1.37)				
Age			0.007			
2 years	1.31	(1.01-1.70)		1.31	(1.02-1.70)	0.038
3 years	1.31	(1.03-1.67)		1.32	(1.04-1.68)	0.023
4 years	0.97	(0.75-1.26)		0.97	(0.75-1.26)	0.975
5 years	1.00			1.00		
Ethnicity			0.059			
White	1.39	(1.06-1.82)		1.39	(1.06-1.83)	0.016
Brown	1.37	(1.00-1.88)		1.36	(1.00-1.86)	0.052
Black	1.00			1.00		
Level 2 – Socioeconomic						
Mother's schooling			0.847			
< 9 years	0.93	(0.69-1.24)		#		
9 to 11 years	0.96	(0.72-1.28)				
> 11 years	1.00					
Monthly household income			0.749			
< 1.5 times min. wage	0.95	(0.77-1.16)		#		
1.5 to 2 times min. wage	1.02	(0.83-1.27)				
> 2 times min. wage	1.00					
Level 3 – Behavioral						
Breastfeeding duration			<0.001			
< 6 months	1.63	(1.32-2.03)				
6 to 12 months	1.49	(1.18-1.89)		#		
> 12 months	1.00					
Pacifier use			<0.001			
Never	1.00			1.00		
Used in past	2.10	(1.55-2.85)		2.13	(1.57-2.89)	<0.001
Continues using	3.15	(2.43-4.08)		3.04	(2.34-3.95)	<0.001
Bottle feeding			0.001			
Never	1.00					
Used in past	1.60	(1.02-2.51)		#		
Continues using	2.03	(1.33-3.10)				

* Level 1: estimates adjusted for other variable on same level; Level 3: estimates adjusted for significant variables on Level 1

Variables not included or that did not remain in multivariate model

^{9,22} with the association going in both directions, but with the introduction of the pacifier always prevailing as the cause for the discontinuation of breastfeeding. Likewise, bottle feeding is a risk factor for the discontinuation of breastfeeding and is also associated with pacifier use.

The reduction in the prevalence of distocclusion with the increase in age is directly related to the reduction in the prevalence of pacifier use, as suggested by the additional analysis performed in the present study. However, it should be pointed out that nearly one third of the children continued to exhibit distocclusion after four years of age, which may be the result of other factors acting jointly as well as the residual effect of pacifier use. The fact that 16% of the children exhibited distocclusion despite never having used a pacifier demonstrates that other factors contribute to this outcome.

Besides inherited characteristics, which play a major role in the bone development pattern of distocclusion, it is possible that factors specific to ethnic groups participate in the network of causality. In the present study, distocclusion was significantly more prevalent among white children in comparison to black children. A previous study reports a greater prevalence rate of distocclusion among children of European descent in comparison to those of African-American descent.¹⁷

Among the implications of the present findings, it is important to counsel pregnant women to avoid allowing their children to use a pacifier or at least diminish the duration of this practice. This measure has the potential to reduce the occurrence of canine distocclusion and its consequences. In a randomized clinical trial, the authors found that a breastfeeding promotion program in the first year of life led to a significant reduction in pacifier use among children in the city of São Leopoldo, Brasil.¹⁹ Pacifier use is also a risk factor for other outcomes, such as speech problems²³ an increased incidence of acute otitis media and other infections²⁴⁻²⁵ as well as other types of malocclusion.^{16,26-27} Thus, actions aimed at promoting breastfeeding and diminishing the use of a pacifier can assist in combating risk factors that are common to different adverse health conditions, which seems to be the most effective prevention strategy.²⁸

The present findings underscore the need for clinical trials that investigate the effects of counseling with regard to the promotion of breastfeeding and the non-use of pacifiers and that measure the effects on the reduction of distocclusion and other malocclusions that affect the primary dentition.

Besides the cross-sectional design, the present study has other limitations that should be addressed. Although the outcome was measured objectively, it is possible that some degree of measurement bias may have occurred. However, it is likely that the effect of such bias was small, as substantial inter-examiner and intra-examiner agreement was found in the reliability tests regarding the diagnosis of malocclusion. Among the independent variables, there may have been a reasonable degree of information bias, especially with regard to behavioral characteristics. Unlike some previous study, multivariate analysis was performed in the present investigation, which diminishes the possibility of confounding. Moreover, the use of Poisson regression with robust variance provided the prevalence ratio as a measure of effect, which is easier to interpret by individuals who are not epidemiologists than the odds ratio²⁹ commonly employed in previous studies.

The findings can be generalized to populations with similar characteristics to those in the present study, such as populations that live in a developing country with a broad ethnic spectrum and a predominantly low socioeconomic status.

CONCLUSION

- - The prevalence of distocclusion was high in the population and was more frequent in younger children, those classified as white, those who used a pacifier and those who continued to use a pacifier.
- - These findings indicate the need for policies that promote healthy behaviors, including reducing the use of pacifiers and encouraging breastfeeding to reduce the prevalence of distocclusion and other child health outcomes that share the same causes.

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