Association between anterior open bite and impact on quality of life of preschool children

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Abstract: The aim of this study was to evaluate the association between different types of malocclusion and the impact on quality of life among preschoolers and their families. A cross-sectional study was carried out involving 451 children 3-5 years of age. A clinical exam was performed to evaluate the malocclusions according to criteria proposed by Foster and Hamilton. This examination was conducted by a calibrated dentist. Parents/caregivers answered the Early Childhood Oral Health Impact Scale (ECOHIS) for the assessment of Oral Health-Related Quality of Life (OHRQoL) and the questionnaire on socioeconomic and demographic characteristics. Data analysis involved descriptive statistics, chi-square, Mann-Whitney and hierarchically adjusted Poisson regression. The prevalence of malocclusion was 28.4%. The most frequent conditions were posterior crossbite (20.4%), anterior open bite (9.5%) and increased overjet (8.4%). A significant association was found between anterior open bite and OHRQoL ($p < 0.001$). The adjusted analysis confirmed the association between anterior open bite and a negative impact on quality of life (PR = 2.55; 95%CI: 1.87 to 3.47; $p < 0.001$). Anterior open bite was associated with a negative impact on the quality of life of preschoolers.

Keywords: Malocclusion; Child, Preschool; Quality of Life.

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Introduction

In Brazil, the frequency of malocclusion among preschool children is as high as 69.9%.[1] However, the prevalence varies according to the parameters used for the diagnosis. Bear in mind that other studies have reported lower rates than this study.[2,3,4,5] A longitudinal study found that children with anterior open bite, increased overjet and posterior crossbite in the primary dentition are at greater risk of exhibiting the same characteristics in the mixed dentition.[6] A clinical trial reported that the diagnosis of malocclusion in the mixed and permanent dentitions may be based on bite characteristics in the primary dentition.[7] These studies demonstrate the importance of detecting malocclusion in preschool children as a prognostic action allowing early planning of treatment.

However, the early diagnosis of malocclusion is hindered by the low percentage of preschoolers who visit the dentist.[8] Therefore, the evaluation of parents' perceptions regarding oral health is particularly important in this population. The combination of oral health status –

evaluated according to normative clinical criteria – and investigation of Oral Health-Related Quality of Life (OHRQoL) constitutes an important tool for clinical decision-making and the establishment of priorities in public oral health policies.

The investigation of OHRQoL among preschoolers is carried out with the assistance of parents, since children younger than 6 years of age may not remember events accurately in a time interval greater than 24 hours[9] and have limitations regarding the verbalization of emotions and anguish.[10] The Early Childhood Oral Health Impact Scale (ECOHIS) is a practical questionnaire that can be used in epidemiological surveys[11] and be administered to parents/caregivers of preschool children. It has been translated and validated in Brazilian Portuguese.[12]

The majority of studies employing the ECOHIS have not found a significant association between malocclusion and impact on quality of life among preschool children.[2,3,5,13,14,15] However, many studies have considered only the presence/absence of malocclusion in the analysis. Thus, the aim of the present study was to evaluate associations between different types of malocclusion and the impact on the quality of life of preschool children and their families.

Methodology

A population-based, cross-sectional study was conducted involving preschoolers in Diamantina, a city in the state of Minas Gerais, in southeastern Brazil. A total of 1109 children are enrolled in preschools and distributed among the 20 preschools of the city.[16] The sample size calculation was performed using a 46.7% prevalence rate of impact from malocclusion on the quality of life of preschool children,[1] a 95% confidence interval and 5% standard error. The minimum sample was defined as 382 preschool children. A design effect of 1.1 was applied to increase the precision. An additional 84 children were added to compensate for possible losses. The sample distribution was proportional to the total population enrolled in private and public preschools in the city. Accordingly, seven public and two private preschools were selected, totaling 517 enrolled children who fulfilled the inclusion criteria. Of these, 504 children were randomly selected for inclusion in the study.

The inclusion criteria were: age 3-5 years, enrollment at a preschool/daycare center in an urban area in the city of Diamantina, and parents/guardians fluent in Brazilian Portuguese. The exclusion criteria were: currently undergoing orthodontic treatment and systemic disease. Parents/caregivers were asked to answer the Brazilian version of the ECOHIS[12] and fill out a form addressing sociodemographic information. The ECOHIS was used to assess the impact of malocclusion on quality of life. The clinical oral examination of the children was performed at the preschools by a single dentist. The examiner had previously undergone a calibration exercise, during which interexaminer and intraexaminer Kappa values were greater than 0.8 for all oral conditions evaluated. Both theoretical and practical exercises were performed. After the dentist brushed the child's teeth, he examined the child with a head lamp (PETZL®, Tikka XP, Crolles, France), mouth mirrors (PRISMA, Sao Paulo, Brazil), and both WHO and periodontal probes (Golgran Ind. e Com. Ltda., Sao Paulo, Brazil).

Malocclusion was recorded in the presence of increased overjet, anterior open bite, posterior crossbite and anterior crossbite. The measurement (in millimeters) was performed with the teeth in centric occlusion and the periodontal probe positioned parallel to the occlusal plane. Increased overjet was recorded when the distance was > 3 mm. Anterior open bite was recorded in the absence of a vertical overlap of the incisors in the occlusal position. Posterior crossbite was recorded when upper primary molars were occluded in a lingual relationship to the lower primary molars. Anterior crossbite was recorded when the lower incisors were observed in front of the upper incisors. These diagnostic criteria of malocclusion were defined by Foster and Hamilton.[17]

Dental caries and traumatic dental injury (TDI) were evaluated as possible confounding variables. The clinical diagnosis of dental caries was assessed based on WHO criteria.[18] TDI was performed using the criteria proposed by Andreasen and Lovschall.[19] The pilot study showed no need for modification of the methodology.

Statistical analysis was performed using the SPSS 20.0 program for Windows (SPSS Inc., Chicago, USA). The Kolmogorov-Smirnov test was used to evaluate the

normality of quantitative variable distributions. Based on the results, the nonparametric Mann-Whitney test was employed. The dependent variable was impact from oral conditions on quality of life (total ECOHIS score).

The independent variables were grouped into a hierarchy of categories ranging from distal to proximal determinants.[20,21] Poisson regression analysis with robust variance was performed for each level, to associate the overall mean ECOHIS score with each clinical oral condition, sociodemographic factor and characteristic of the child. This analysis was performed to exclude variables with a *p*-value of < 0.20. Only explanatory variables with a *p*-value of < 0.05 after adjustment for variables on the same or prior levels of determinants were selected for the final models. In these analyses, the outcome was employed as a count total.

This study received approval from the Human Research Ethics Committee of the *Universidade Federal de Minas Gerais* (Belo Horizonte, Brazil) (CAAE: 09066012.3.0000.5149). All parents/guardians received information regarding the objectives of the study, and signed a statement of informed consent.

Results

A total of 499 preschool children were initially enrolled in the present investigation, 451 (90.4%) of whom participated until the end of the study. The main reason for losses was that parents/caregivers failed to fill out the questionnaire. Mean age (standard deviation) of the preschool children was 4.25 (0.83) years; 53.9% were female. The prevalence of malocclusion was 28.4%. The most frequent conditions were posterior crossbite (20.4%), anterior open bite (9.5%) and accentuated overjet (8.4%). Dental caries and TDI were present in 34.8% and 17.5% of the sample, respectively.

The majority of parents/caregivers reported no impact on quality of life (52.8%). Parents reported more impacts related to the child (42.8%) than the family (29.3%). Table 1 displays the mean ECOHIS scores (total and domain), according to the different oral clinical conditions. Significant associations were found between impact on the child's and family's quality of life and both anterior open bite and dental caries.

The univariate analysis considering the characteristics of the preschool children, as well as demographic factors, revealed that impact on quality of life was associated with the age of the child and with the mother working outside the home. Regarding clinical oral conditions, anterior open bite and dental caries were associated with a greater impact prevalence rate (Table 2).

In the final multivariate model (Table 3), anterior open bite (PR: 2.55; 95%CI: 1.87 to 3.47; *p* < 0.001), dental caries (PR: 6.87; 95%CI: 5.04 to 9.36; *p* < 0.001) and lower level of mother's schooling were associated with a negative impact on quality of life.

Discussion

The prevalence rate of malocclusion in the present study (28.4%) was lower than the rate reported in a previous Brazilian investigation (46.7%).[5] However, the cutoff point for increased overjet was 2 mm in the study cited and > 3 mm in the present investigation. Overjet up to 3 mm in the primary dentition is not considered a risk factor for malocclusion in mixed dentition.[6] However, previous studies have found an association between overjet greater than 3 mm and TDI.[22,23] This reinforces the importance of evaluating increased overjet, considering a cutoff point of > 3 mm. Another Brazilian study reports a 69.9% prevalence rate of malocclusion in the anterior region, using a cutoff point of > 2 mm for determining increased overjet.[1] Since young children may exhibit nonnutritive sucking habits,[24] it is important to stress than the mean age of the children in the present study was 4.25 (SD = 0.83) years, whereas mean age in the study by Kramer *et al*.[1] was 3.5 (SD = 1.0) years. This result may show that the damage caused by nonnutritive sucking habits can be corrected spontaneously after cessation of these habits.[25]

The present investigation evaluated the impact of different types of malocclusion on quality of life among preschool children, in contrast to many studies[3,5,13] that confirm this relationship based solely on the presence/absence of this oral disorder. Parents of children with anterior open bite reported negative impacts on most of the ECOHIS domains, with the exception of "symptoms." Considering the mean total ECOHIS score, only anterior open bite and dental caries were significantly associated with impact on quality of life.

Table 1. Mean scores on ECOHIS domains according to different oral clinical conditions.

Oral clinical conditions	n (%)	SD	FD	PD	SSD	PDD	FFD	Mean ECOHIS score
Anterior open bite								
Absent	408 (90.5)	0.74 (1.20)	1.02 (2.21)	0.64 (1.41)	0.53 (1.49)	1.02 (2.06)	0.31 (1.07)	4.15 (7.50)
Present	43 (9.5)	1.12 (1.40)	3.77 (3.27)	2.26 (2.90)	1.67 (2.36)	3.12 (2.96)	1.56 (1.94)	11.65 (10.35)
p-value		0.079	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Increased overjet								
Absent	413 (91.6)	0.80 (1.24)	1.24 (2.42)	0.77 (1.61)	0.63 (1.61)	1.22 (2.23)	0.36 (1.15)	4.77 (8.04)
Present	38 (8.4)	0.53 (1.01)	1.74 (2.89)	1.16 (2.23)	0.82 (1.74)	1.21 (2.44)	1.21 (1.76)	5.89 (8.85)
p-value		0.186	0.313	0.272	0.414	0.900	< 0.001	0.070
Posterior crossbite								
Absent	359 (79.6)	0.83 (1.23)	1.18 (2.32)	0.72 (1.47)	0.60 (1.56)	1.16 (2.15)	0.34 (1.14)	4.69 (7.72)
Present	92 (20.4)	0.59 (1.17)	1.67 (2.93)	1.09 (2.29)	0.80 (1.84)	1.46 (2.58)	0.77 (1.51)	5.59 (9.46)
p-value		0.040	0.326	0.555	0.594	0.537	0.002	0.979
Anterior crossbite								
Absent	447 (99.1)	0.78 (1.22)	1.30 (2.47)	0.79 (1.68)	0.65 (1.64)	1.21 (2.24)	0.43 (1.24)	4.87 (8.14)
Present	4 (0.9)	0.80 (1.09)	0.20 (0.45)	1.80 (0.48)	0.10 (0.25)	2.00 (2.83)	0.40 (0.89)	5.20 (1.35)
p-value		0.848	0.517	< 0.001	0.326	0.455	0.786	0.072
Dental caries								
Absent	294 (65.2)	0.17 (0.54)	0.43 (1.20)	0.19 (0.69)	0.08 (0.45)	0.36 (1.20)	0.22 (0.82)	1.43 (3.30)
Present	157 (34.8)	1.92 (1.32)	2.89 (3.29)	1.94 (2.28)	1.70 (2.35)	2.83 (2.80)	0.82 (1.70)	11.21 (10.24)
p-value		< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Traumatic dental injury								
Absent	372 (82.5)	0.77 (1.20)	1.37 (2.55)	0.81 (1.70)	0.67 (1.71)	1.31 (2.33)	0.41 (1.24)	5.03 (8.41)
Present	79 (17.5)	0.80 (1.33)	0.90 (1.96)	0.72 (1.58)	0.51 (1.12)	0.78 (1.77)	0.51 (1.21)	4.13 (6.48)
p-value		0.842	0.143	0.696	0.707	0.091	0.440	0.728

Values expressed as mean (standard deviation); Mann-Whitney test.
SD = symptoms domain (score ranges from 0 to 5); FD = function domain (score ranges from 0 to 0 to 16); PD = psychological domain (score ranges from 0 to 8); SSD = self-image/social interaction domain (score ranges from 0 to 8); PDD = parent distress domain (score ranges from 0 to 8); FFD = family function domain (score ranges from 0 to 8).

Because other risk factors may cause interference, it is important to consider possible correlations with confounding factors.[26,27] In the present study, caries and TDI were investigated as potential confounding variables. Moreover, Locker[28] suggests that the relationship between oral health and quality of life outcomes is mediated by personal and environmental variables. This demonstrates the importance of evaluating demographic factors, as was done in the present study.

Regarding type of malocclusion, the univariate analysis showed that anterior open bite was significantly associated with a negative impact on quality of life; this was confirmed in the final Poisson regression model. This finding is noteworthy, since the same association occurred with dental caries, which is an important confounding variable. A study with preschoolers in the city of Canoas, Brazil, also found an association between malocclusion and quality of life.[1]

It is important for parents/caregivers to perceive the functional limitations associated with anterior open bite, such as difficulty eating and pronouncing words, since this malocclusion may be carried over into the mixed dentition.[6] Moreover, the satisfaction/dissatisfaction expressed by parents with regard to their child's oral health could also be attributed to this association.[29] Perceptions such as these may contribute to the decision to seek treatment. The fact that anterior open bite, dental caries and mother's schooling remained in the final model is in agreement with data described in a study conducted in the city of Santa Maria, in southern Brazil.[30]

Table 2. Univariate analysis of associations among oral clinical conditions, characteristics of children, and both sociodemographic and economic factors in relation to overall ECOHIS.

Covariates	n (%)	PR	p-value
Characteristics of child			
Gender			
Female	243 (53.9)	1	
Male	208 (46.1)	0.99 (0.77-1.27)	0.973
Age			
3 years	114 (25.2)	1	
4 years	109 (24.2)	1.77 (1.12-2.79)	0.004
5 years	228 (50.6)	1.79 (1.20-2.66)	0.013
Sociodemographic and economic factors – level 1			
Mother's schooling			
> 11 years	39 (8.6)	1	
> 8 to 11 years	216 (47.9)	7.16 (2.62-19.60)	< 0.001
≤ 8 years	196 (43.5)	7.83 (2.73-22.45)	< 0.001
Mother works outside the home			
Yes	329 (72.9)	1	
No	122 (27.1)	0.51 (0.37-0.69)	< 0.001
Household income			
> 3 times the minimum wage	80 (17.7)	1	
3 times the minimum wage	138 (30.6)	0.81 (0.49-1.33)	0.406
≤ 2 times the minimum wage	233 (51.7)	0.85 (0.52-1.38)	0.513
Type of school (child)			
Private	35 (7.8)	1	
Public	416 (92.2)	0.529 (0.20-1.37)	0.192
Oral clinical conditions – level 2			
Anterior open bite			
Absent	408 (90.5)	1	
Present	43 (9.5)	3.75 (2.26-6.24)	< 0.001
Increased overjet			
Absent	413 (91.6)	1	
Present	38 (8.4)	1.54 (0.98-2.41)	0.058
Posterior crossbite			
Absent	359 (79.6)	1	
Present	92 (20.4)	0.65 (0.41-1.03)	0.067
Anterior crossbite			
Absent	447 (99.1)	1	
Present	4 (0.9)	1.12 (0.57-2.22)	0.738
Dental caries			
Absent	294 (65.2)	1	
Present	157 (34.8)	8.54 (6.42-11.36)	< 0.001
Traumatic dental injury			
Absent	372 (82.5)	1	
Present	79 (17.5)	1.18 (0.83-1.67)	0.350

PR calculated by the Wald chi-square test; the minimum wage is approximately US$305.00.

Table 3. Final Poisson regression model for covariates associated with overall ECOHIS.

Covariates	Robust PR	p-value
Characteristics of child		
Gender		
Female	1	
Male	1.01 (0.74-1.37)	0.933
Age		
3 years	1	
4 years	2.56 (1.46-4.50)	0.001
5 years	3.19 (2.04-4.93)	< 0.001
Socio-demographic and economic factors – level 1		
Mother's schooling		
> 11 years	1	
> 8 to 11 years	6.10 (2.87-12.95)	< 0.001
≤ 8 years	7.68 (3.61-16.33)	< 0.001
Age		
3 years	1	
4 years	2.81 (1.64-4.80)	< 0.001
5 years	3.18 (2.02-5.00)	< 0.001
Oral clinical conditions – level 2		
Anterior open bite		
Absent	1	
Present	2.55 (1.87-3.47)	< 0.001
Dental caries		
Absent	1	
Present	6.87 (5.04-9.36)	< 0.001
Age		
3 years	1	
4 years	1.61 (1.02-2.54)	0.058
5 years	1.59 (1.05-2.42)	
Mother's schooling		
> 11 years	1	
> 8 to 11 years	3.53 (1.84-6.76)	< 0.001
≤ 8 years	3.23 (1.66-6.25)	0.001

PR calculated by Wald chi-square test; model adjusted for significant variables in the final model of previous levels.

The results of this research are not in agreement with other recent Brazilian studies.[2,15] One study[15] did not use a quantitative dependent variable. The authors of this paper[15] used the response "occasionally" as the cutoff point for determining the prevalence of a negative impact. Abanto et al.[2] assessed children 1-4 years of age. In the study performed by Sousa et al.,[15] 78% of the sample consisted of children 3 and 4 years of age, whereas 22% were 5 years of age. In the present study, 50.6% of the sample consisted of children 5 years of age. Since parents can understand the limitations of older children more easily, the sampling process may explain the difference in the results.

The present findings suggest that quality of life measures provide important information for clinical decision-making regarding the treatment of malocclusion. However, the present investigation has the limitation of being a cross-sectional and epidemiologic study. Furthermore, information and selection biases may have occurred.

Conclusion

Anterior open bite was associated with a negative impact on quality of life among preschool children and their families.

Acknowledgments

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