Original Article

Impact of anterior occlusal conditions in the mixed dentition on oral health–related quality-of-life item levels:
A multivariate analysis

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ABSTRACT

Objectives: To evaluate the impact of anterior occlusal conditions in the mixed dentition on item-level analysis of oral health–related quality of life (OHRQoL).

Materials and Methods: A population-based cross-sectional study of 787 children aged 8 to 10 years was conducted. The Child Perceptions Questionnaire (CPQ_{8-10}) was used to evaluate OHRQoL, and the analysis of item levels was performed on CPQ_{8-10} domains. Anterior occlusal characteristics were diagnosed according to the Dental Aesthetic Index criteria. Individual analyses were performed relating the outcome as independent variables. The variables with $P < .20$ in the individual analyses were tested in multiple logistic regression models, and those with $P < .10$ remained in the model. The adjusted odds ratio (OR) was estimated with a 95% confidence interval (CI).

Results: No associations were found with regard to anterior occlusal characteristics ($P < .001$) after the variables of the previous determinants were adjusted for multivariate analysis. However, the following variables were significantly associated with negative impact on OHRQoL item levels: sex, in oral symptoms (OR = 1.42; CI, 1.07–1.89) and emotional well-being (OR = 1.34; CI, 1.00–1.79); race, in oral symptoms (OR = 1.48; CI, 1.10–1.98), emotional well-being (OR = 1.54; CI, 1.14–2.06), and social well-being (OR = 1.34; CI, 1.00–1.80); and family income in functional limitation (OR = 1.46; CI, 1.06–2.02), emotional well-being (OR = 1.71; CI, 1.21–2.42), and social well-being (OR = 1.59; CI, 1.14–2.21).

Conclusions: Anterior occlusal conditions did not affect the levels of OHRQoL items. (*Angle Orthod.* 2020;90:564–570.)

KEY WORDS: Mixed dentition; Quality of life; Oral health; Malocclusion

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INTRODUCTION

Malocclusions are the result of multiple genetic and environmental factors. During development of the dentition, primary occlusion may improve or often worsen when the child transitions from the primary to the permanent dentition.[1] Mixed dentition is a transitional stage, characterized by a wide range of occlusal variations[2] and a high prevalence of malocclusion.[1,3–7] In addition, occlusal conditions, such as increased overjet, deep overbite, dental crowding, and spacing, are malocclusions usually associated with dissatisfaction with dental appearance.[4] However, studies addressing the impact of occlusal conditions in the mixed dentition only quantified malocclusion[3,7–9] and did not consider the physiological changes inherent in this stage.

A difficult aspect of occlusal evaluation in the mixed dentition is the prolonged period of development, including facial growth and dimensional changes of the dental arches.[4] Several changes are established at the transition stage from the deciduous to the permanent dentition, but they do not necessarily define a malocclusion. The major variability is related to the position of the incisors and their alignment,[2,10] with direct impact on the esthetics of the smile.

To avoid early functional and psychological harm, assessment of the occlusion in the mixed dentition is essential. Malocclusions have negative effects on children's and adolescent's oral health–related quality of life (OHRQoL),[11,12] especially if the malocclusions are present in the esthetic zone.[10] However, the OHRQoL may differ between countries and societies, as a self-perceived measure can be dependent on the context of the child.[12,13]

OHRQoL is suggested to be a multidimensional concept, influenced by individual factors and dynamics and modulated over time.[12] The older children become, the more their malocclusion affects their OHRQoL, and this relation becomes evident at about 8 years old.[3,11] At this age, the child is in the mixed dentition, and conditions of the occlusion may negatively affect OHRQoL.[3,4,7,11,12] However, studies generally evaluate malocclusion[3,7–9] and not specific occlusal conditions. The associations between anterior occlusion characteristics and OHRQoL varied among various subgroups in malocclusion assessments[12] and justifies the study of such occlusal conditions in the mixed dentition.

This study was based on the hypothesis that the associations within malocclusion subgroups can be translated to a certain domain of OHRQoL. Thus, the aim of this study was to evaluate the impact of anterior occlusal conditions in the mixed dentition on the item-level analysis of OHRQoL.

MATERIALS AND METHODS

Study Design, Participants, and Sample Size

This study received approval from the Human Research Ethics Committee of Brazil (No. 80184717.1.0000.5385). Informed consent was obtained from parents and subjects before data collection.

A population-based cross-sectional study was conducted involving children enrolled in public schools distributed throughout every neighborhood of the city of Araras, located in the state of São Paulo in Southeast Brazil. Araras has an estimated population of 188,843 inhabitants and a human development index of 0.78.[14] A representative sample of 8- to 10-year-old children enrolled in all public schools of the city was selected.

Initially, 11 of the 15 schools were selected through stratified random sampling according to the population of schoolchildren across the neighborhoods. Then, all 8- to 10-year-old subjects of the selected schools were invited to participate. Data collection was performed between August and November 2017.

The sample size was calculated considering a confidence interval (CI) of 95%, a test power of 80%, and an effect size of 1.5.[4] The minimum sample size was defined as 650 children. Twenty percent of children were added to compensate for possible nonparticipations, with a final sample size estimated at 780 in the group between 8 and 10 years of age.

The mixed dentition was determined based on the dental age, proposed by Van der Linden (1983).[15] According to this reference, the mixed dentition presents two important exchange periods of deciduous and permanent teeth: early (first transitional period) and late (second transitional period) mixed dentition. In this study, all children were in the late-mixed dentition period. Current orthodontic treatment, primary dentition, early mixed dentition, and complete permanent dentition, along with systemic diseases, such as cerebral palsy or Down syndrome, were exclusion criteria. The final sample comprised 787 individuals (391 boys and 396 girls) aged 8 to 10 years.

Study Instruments and Variables

The outcome variable was OHRQoL at an item level. The Brazilian version of the Child Perceptions Questionnaire for children from 8 to 10 years old (CPQ$_{8-10}$) was used to evaluate the impact on OHRQoL.[16,17] The questions were related to the frequency of events occurring in the past 3 months. The CPQ$_{8-10}$ is composed of 25 questions divided into four domains: oral symptoms (five questions), functional limitations (five questions), emotional well-being (five questions), and social well-being (10 questions). The instrument has been self-applied. The answers followed the Likert scale: *never* = 0, *once/twice* = 1, *sometimes* = 2, *often* = 3, and *every day or almost every day* = 4. The CPQ$_{8-10}$ total score was obtained as a sum of the 25 items, and subscale scores were obtained by adding related item scores. The result of each item level was dichotomized by the median[18]; lower scores indicated no impact on OHRQoL, and higher values indicated a negative impact on OHRQoL.[3,4,18]

The independent variables were classified into clinical (anterior occlusal conditions), demographic (age, sex and race), and socioeconomic characteristics (family income).

Clinical examination was performed using the Dental Aesthetic Index (DAI).[19] The DAI is a numerical index that evaluates the 10 occlusal characteristics selected

according to their potential to cause psychosocial incapacity. The occlusal characteristics were grouped into the following three dimensions: dentition, spacing, and occlusion. Normally, the DAI is analyzed by means of the sum of scores of each characteristic evaluated added to a constant value. This sum leads to a classification that identifies the orthodontic treatment need of individuals determined by the severity of the occlusal conditions. In the present study, for the purposes of analysis, the index was not calculated mathematically, but its components were used separately with the goal of verifying which of them were related to OHRQoL: anterior crowding, anterior spacing, midline diastema, anterior open bite, and anterior maxillary overjet.

The presence of crowding in the anterior segments, including the four permanent incisors, was observed in the upper and lower arches. Crowding was considered when the space between the right and left canines was insufficient to accommodate the four incisors in alignment. Crowding in the anterior segment was classified as follows: $0 =$ no crowding in the upper and lower segments, $1 =$ crowding in one segment (upper or lower), and $2 =$ crowding in two segments (upper and lower). For data analysis, it was dichotomized as $0 =$ absence of crowding and 1 and $2 =$ presence of crowding. Anterior spacing was considered when the space between the right and left canines was larger than required for the normal alignment of incisors. Spacing in the anterior segment was classified as follows: $0 =$ no spacing, $1 =$ spacing in one segment (upper or lower), and $2 =$ spacing in two segments (upper and lower). For data analysis, it was dichotomized as $0 =$ absence of anterior spacing and 1 and $2 =$ presence of anterior spacing. Diastema in the midline between the permanent upper central incisors was registered in millimeters from the height of the line of adjacent teeth or at the point of greater convexity of the proximal surface. The values considered were ≤ 1 mm $=$ absence of a diastema and $>1 =$ presence of a diastema. An anterior open bite was assessed in millimeters with the periodontal probe, from the middle of the incisal margin of the teeth involved. The values considered were 0 mm $=$ normal overbite and ≥ 1 mm $=$ presence of an anterior open bite. Anterior maxillary overjet was measured in millimeters as the distance between the buccal incisal margin of the most protruded upper incisor and the buccal surface of the corresponding lower incisor, with the periodontal probe placed in contact with the buccal surface of the lower incisor, parallel to the occlusal plane and perpendicular to the arch line. The values from 2 to 3 mm $=$ normal anterior maxillary overjet, 1.5 to 0 mm $=$ decreased anterior maxillary overjet, and >3 mm $=$ increased anterior maxillary overjet.

Parents or guardians answered a questionnaire on socioeconomic data. The questionnaire provided information on household income. Household income was measured in Brazilian Reais (R $1 =$ US $0.307), and it was dichotomized into high ($\leq$R $2.000) and low (R $\geq$2.000) categories by the median of the data.

Clinical Examination and Calibration

A previously trained examiner performed the examinations under artificial light at the schools. Before the study began, a calibration process was conducted to obtain acceptable consistency for all of the clinical conditions. The training stage consisted of a theoretical discussion followed by a practical stage. During training and calibration, the inter- and intraexaminer agreement was estimated via the intraclass correlation coefficient for the components of the DAI, with an acceptable limit value greater than .92.

Data Analysis

Individual analyses were performed using OHRQoL item levels as outcome and the independent variables (age, sex, race, family income, anterior crowding, anterior spacing, midline diastema, and maxillary anterior horizontal overlap). Initially, the raw odds ratio (OR) was estimated with a CI of 95%. The variables with $P < .20$ in the individual analyses were tested in the multiple logistic regression models, and those with $P < .05$ remained in the model, with the adjusted OR estimated with a CI of 95%. Analyses were performed in the R program (R Foundation for Statistical Computing, Vienna, Austria).

RESULTS

Sociodemographic and malocclusion characteristics as well as OHRQoL measures, according to sex and family income groups, are presented in Table 1. A total of 787 children were examined. Of these, 396 (50.3%) were girls and 478 were white (60.7%). Most of the children belonged to families with low incomes, with a reported income of $\leq$R $2.000. Overall, girls and those from low-income families had poorer CPQ$_{8-10}$ than boys. Anterior spacing and midline diastema were anterior occlusal conditions more common in the mixed dentition.

The results of the multivariate analysis are shown in Table 2. Female sex was significantly associated with a negative impact on OHRQoL item levels: oral symptoms (OR $= 1.42$; CI, 1.07–1.89) and emotional well-being (OR $= 1.34$; CI, 1.00–1.79). Nonwhite race was significantly associated with negative impact on OHRQoL item levels: oral symptoms (OR $= 1.48$; CI, 1.10–1.98), emotional well-being (OR $= 1.54$; CI, 1.14–

Table 1. Multivariate Analysis Parameters and OHRQoL Item-Level Measures According to the Presence of an Impact on Each Domain of the CPQ[8-10] (n = 787)[a]

	With Impact, n (%)			
Variable	Oral Symptoms	Functional Limitations	Emotional Well-being	Social Well-being
Age, y, n (%)				
≤9 (n = 491)	217 (44.2)	236 (48.1)	183 (37.3)	209 (42.6)
>9 (n = 296)	131 (44.2)	133 (44.9)	133 (44.9)	141 (47.6)
Gender, n (%)				
Male (n = 391)	156 (39.9)	169 (43.2)	142 (36.3)	167 (42.7)
Female (n = 396)	192 (48.5)	200 (50.5)	174 (43.9)	183 (46.2)
Race, n (%)				
White (n = 478)	192 (40.2)	216 (45.2)	171 (35.8)	197 (41.2)
Nonwhite (n = 309)	156 (50.5)	153 (49.5)	145 (46.9)	153 (49.5)
Family income, n (%)[b]				
Low, ≤R $2000,00 (n = 582)	266 (45.7)	287 (49.3)	255 (43.7)	277 (47.6)
High, >R $2000,00 (n = 205)	82 (40.0)	88 (42.9)	67 (32.7)	79 (38.5)
Anterior crowding, n (%)				
Absence (n = 432)	190 (44.0)	207 (47.9)	176 (40.7)	190 (44.0)
Presence (n = 355)	158 (44.5)	162 (45.6)	140 (39.4)	160 (45.1)
Anterior spacing, n (%)				
Absence (n = 342)	159 (46.5)	158 (46.2)	140 (40.9)	159 (46.5)
Presence (n = 445)	189 (42.5)	211 (47.4)	176 (39.5)	191 (42.9)
Midline diastema, n (%)				
Absence (n = 387)	181 (46.8)	183 (47.3)	161 (41.6)	178 (46.0)
Presence (n = 400)	167 (41.7)	186 (46.5)	155 (38.7)	172 (43.0)
Overjet, n (%)				
Decreased (n = 228)	106 (46.5)	110 (48.2)	92 (40.3)	99 (43.4)
Normal (n = 331)	146 (44.1)	144 (43.5)	129 (39.0)	138 (41.7)
Increased (n = 228)	96 (42.1)	121 (53.1)	95 (41.7)	119 (52.2)
Anterior open bite, n (%)				
Absence (n = 721)	324 (44.9)	341 (47.3)	288 (39.9)	314 (43.5)
Presence (n = 66)	24 (36.4)	34 (51.5)	34 (51.5)	42 (63.6)

[a] Values are given as n (%). The mean total CPQ[8-10] score was 13.92; CPQ dimension: oral symptoms was 5.31; CPQ dimension: functional limitation was 2.27; CPQ dimension: emotional well-being was 3.32; CPQ dimension: social well-being was 2.25. Child Perceptions Questionnaire (CPQ[8-10]) Impact Short Form validated for Brazilian children.

[b] When the study was conducted, the minimum wage in Brazil was R $880, and 1 Brazilian Real was equivalent to US $0.307. The data were dichotomized as high (≤R $2.000) and low (R $≥2.000) family income by the median.

2.06), and social well-being (OR = 1.34; CI, 1.00–1.80). The family income (low or high) was significantly associated with negative impact at OHRQoL item levels: functional limitation (OR = 1.46; CI, 1.06–2.02), emotional well-being (OR = 1.71; CI, 1.21–2.42), and social well-being (OR = 1.59; CI, 1.14–2.21). No associations were found with regard to anterior occlusal characteristics ($P < .001$) after the variables were adjusted.

DISCUSSION

The impact of malocclusions on OHRQoL in children with mixed dentition is still controversial, as some occlusal characteristics are inherent to this stage of development. Children's ages and, consequently, their dentition stages have a major influence on the association between malocclusions and OHRQoL. The life changes of children between the ages of 11 and 14 years make them more likely to experience the impact of malocclusions on OHRQoL.[13]

Few studies[3,7–9] have evaluated malocclusion in children aged 8–10 years using CPQ[8-10], based on the DAI. In addition, the studies[3,7–9] quantified only malocclusion; they did not consider the physiological characteristics of occlusion. In the current study, only the parameters of the DAI were used to diagnose the anterior occlusal characteristics by the four domains, as well as the CPQ[8-10] to evaluate OHRQoL. This study will contribute to the literature by fostering an understanding of how anterior physiological conditions from the transition of primary to permanent teeth affect OHRQoL.

The findings rejected the study hypothesis because, even when the quality of life was evaluated based on the item levels, the anterior occlusal characteristics in the mixed dentition had no impact on the OHRQoL. Previous studies[3,4,7,8,20–29] showed that an increased overjet and increased spacing, especially a midline diastema, were the conditions that most affected the individual, regardless of age. Still, the older children become, the more their malocclusion affects their

Table 2. Association Between Demographic and Socioeconomic Variables, Anterior Occlusal Conditions, and Negative Impact on CPQ Domains

Variable	Category	Oral Symptoms		Functional Limitations		Emotional Well-being		Social Well-being	
		OR Gross (CI)	OR Adjust (CI)	OR Gross (CI)	OR Adjust (CI)	OR Gross (CI)	OR Adjust (C)	OR Gross (CI)	OR Adjust (CI)
Age, y	≤9[&]	Ref.		Ref.		Ref.		Ref.	
	>9	1.00 (0.75–1.34)		0.88 (0.66–1.18)		1.37[a] (1.02–1.84)		1.23 (0.92–1.64)	
Gender	Male	Ref.	Ref.	Ref.		Ref.	Ref.	Ref.	
	Female	1.42* (1.07–1.88)	1.42* (1.07–1.89)	1.34* (1.01–1.78)		1.37* (1.03–1.83)	1.34* (1.00–1.79)	1.15 (0.87–1.53)	
Race	White	Ref.	Ref.	Ref.		Ref.	Ref.	Ref.	Ref.
	Nonwhite	1.52* (1.14–2.03)	1.48* (1.10–1.98)	1.19 (0.89–1.58)		1.59* (1.19–2.12)	1.54* (1.14–2.06)	1.40* (1.05–1.87)	1.34* (1.00–1.80)
Family's income	Low	1.26 (0.91–1.74)		1.46* (1.06–2.02)	1.46* (1.06–2.02)	1.84* (1.31–2.59)	1.71* (1.21–2.42)	1.64* (1.18–2.28)	1.59* (1.14–2.21)
	High	Ref.		Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Anterior crowding	Absence	Ref.		Ref.		Ref.		Ref.	
	Presence	1.02 (0.77–1.36)		0.91 (0.69–1.21)		0.94 (0.71–1.26)		1.04 (0.79–1.39)	
Anterior spacing	Absence	Ref.		Ref.		Ref.		Ref.	
	Presence	0.85 (0.64–1.13)		1.05 (0.79–1.39)		0.94 (0.71–1.26)		0.86 (0.65–1.15)	
Midline diastema	Absence	Ref.		Ref.		Ref.		Ref.	
	Presence	0.82 (0.62–1.08)		0.97 (0.73–1.28)		0.89 (0.67–1.18)		0.89 (0.67–1.17)	
Overjet	Normal	Ref.		Ref.		Ref.		Ref.	
	Increased	0.92 (0.65–1.30)		1.21 (0.86–1.70)		1.06 (0.75–1.50)		1.37 (0.98–1.93)	
	Decreased	1.10 (0.78–1.54)		1.32 (0.94–1.85)		1.12 (0.79–1.58)		1.07 (0.76–1.51)	
Anterior open bite	Absence	Ref.		Ref.		Ref.		Ref.	
	Presence	0.70 (0.42–1.18)		0.82 (0.49–1.37)		1.11 (0.66–1.85)		1.55 (0.94–2.58)	

[a] Negative impact on domains of OHRQoL.
[&] = Median age; * $P < .05$.

OHRQoL.[12] Maybe in the mixed dentition, children are not yet mature enough to recognize the impact of malocclusion. However, the literature shows that some conditions, such as large overjet and anterior crossbite, affect the OHRQoL at these ages.[11,13]

On the other hand, item-level analysis identified the impact of socioeconomic conditions in some domains of OHRQoL. Children from lower-income families were more likely to report a negative impact on functional limitations, emotional well-being, and social well-being. The results corroborated previous studies[24,27] and showed that underprivileged children had less access to dental treatment, which had a negative influence on OHRQoL. Also, malocclusion and its impact on OHRQoL might be influenced by the local health care system,[13] which adds to the explanation of the differences in the association of malocclusion with OHRQoL among various populations. In addition, a recent meta-analysis confirmed that low individual/household income was associated with several adverse oral health outcomes.[30] Thus, the current

findings suggested that the socioeconomic condition is still a determining factor in the daily life of an individual, often more than esthetics is.

In addition, girls were more dissatisfied with the appearance of their teeth than boy were. The results of the present study showed that girls were more likely to experience an impact on oral symptoms and emotional well-being compared with boys.[31,32] Similarly to adult women, girls are more self-conscious about esthetic appearance,[13,26,33] which therefore had a greater impact on OHRQoL. Thus, the findings confirmed the previous literature.

Finally, the findings suggested that the physiological changes that occur during the transition from primary to permanent dentition did not affect the child's OHRQoL with mixed dentition. The impact of malocclusions on OHRQoL is definitively modified by the age of the children, their cultural environment, and, mainly, their social context. The need still exists for further studies in different socioeconomic regions and a longitudinal assessment that would allow an outcome of the

cause/effect relationship during dentition development. This study showed that malocclusion did not affect OHRQoL of children from 8 to 10 years old. Various subgroups of malocclusion were assessed, and income was still the factor with the greatest effect on OHRQoL.

CONCLUSIONS

- The anterior occlusal conditions did not affect OHRQoL item levels.
- Sex, race, and family income were associated with a greater impact on all OHRQoL item levels.
- The physiological changes that occur during the transition from primary to permanent dentition do not affect the OHRQoL of a child with mixed dentition from 8 to 10 years old.

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