Impact of Malocclusion on Oral Health Related Quality of Life among Brazilian Adolescents

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ABSTRACT

BACKGROUND

Oral health and general health are very closely related and are considered to be important health problems among individuals due to their expenses associated with treatment, prevalence rate and impact level among individuals and adolescents. These investigations can even have key suggestions for general and oral health prevention strategies relevant to the present knowledge on risk factors for these conditions. Assessment of the current impacts of oral health conditions on quality of life might even develop an understanding of the importance of dental conditions. The general purpose of the current thesis was to investigate the association between oral health and its impact on oral health-related quality of life (OHRQoL) among Brazilian adolescents.

METHODS

A population-based birth cohort study was carried out in the urban city of Pelotas, Brazil, in the year 2004 (2004 PBCS), including all live births in the city. All mothers living in the urban area of Pelotas and their children born in maternity hospitals of the city of Pelotas (N = 4231) were eligible to participate in this study.

RESULTS

Findings presented in this thesis indicate that a negative association between oral conditions and OHRQoL exists. Adolescents with severe malocclusion identified with a DAI score greater than 36, showed a negative impact on OHRQoL. Individuals with the presence of dental plaque were seen suffering from severe malocclusion, which in turn was negatively associated with OHRQoL. The evidence provided by the current thesis may not only contribute primarily to the scientific literature but may also furnish researchers and epidemiologists with information vital for orthodontic treatment and be useful to identify community needs and help in the implementation of treatment plans.

CONCLUSIONS

In conclusion, the impact of malocclusion on daily events among adolescents of Brazil was a common finding in our study. Some other important variables like gingival status, schooling of the fathers that possibly act during childhood which might be affecting the QoL were not included in our present study. These findings may not only contribute to the literature but may also furnish researchers and epidemiologists with information vital for orthodontic treatment and use to identify the community needs and help in the implementation of the treatment plan. Further studies need to be developed to clarify the most complex relationship between impacts of malocclusion on QoL.

KEY WORDS

Malocclusion, Epidemiological, Brazilian Adolescents, Oral Health-Related Quality Of Life, Dental Aesthetic Index

BACKGROUND

Malocclusion is the malformation of the maxilla or the mandible and malposition of teeth that may result in physical, psychological, and social consequences.

In the epidemiological field, several indices used to estimate the occurrence of malocclusion play a vital role in assessing the severity, complexity, and treatment outcome of malocclusion. Strategies for recording and measuring malocclusion can be distinguished under qualitative and quantitative techniques. Qualitative methods of estimating malocclusion incorporate indices such as malalignment index and index of tooth position. Quantitative methods of measuring malocclusion as with most of the indices utilized include handicapping labiolingual index, malocclusion severity estimate, occlusal index, dental aesthetic index, treatment priority index.[1]

Malocclusion is the third leading oral condition, secondary to periodontal disease and dental caries.[2,3-5] Malocclusion is highly prevalent among adolescents worldwide and due to its impact on their quality of life it should be considered as a dental public health problem.[6-10] Adolescents and parents perceived untreated malocclusion as a condition that has a psychological and social impact on individual's quality of life[9,11-14] with most of the interventions for this dental disorder made during this stage of people's life. In normal circumstances, adolescents seek dental intervention to enhance their own physical and aesthetic appearance.[13,15,16]

Studies have demonstrated the impact of severe malocclusion on aesthetic appearance and functional limitations. Persistent biting of a cheek, changes in facial appearance, vocalizing issues and mouth breathing are a portion of the significant indications that characterize this debilitating condition.[17,18]

A study suggested that handicapping malocclusion had a negative effect on physical / aesthetic effects and quality of life among Brazilian adolescents. Moreover, malocclusion is associated with emotional and social aspects of an individual's quality of life.[19] Several studies have reported that there is a significant effect of malocclusion on the oral health-related quality of life (OHRQoL) associated with psychological and self-esteem levels of adolescents.[7,20] A study conducted in India showed that anterior traumatic teeth, tooth decay and tooth loss could have a negative impact on psycho-social behaviour which consequently affects their self-esteem.[18] Conversely, a study carried out in Mongolian adolescents showed no significant relation associated with malocclusion and OHRQoL.

According to World Health Organization (WHO), the term health-related quality of life is best described as an individual assessment of how the following factors affect his / her well–being.[21,22] Functional component, psychological component, aesthetic component and pain and discomfort components are the four major components of OHRQoL.[23,24,25]

Although malocclusion is not fatal, it possesses adverse effects on OHRQoL.[26]

The absence of viable data on malocclusion and its effect on adolescent's quality of life contributes immensely to the literature and furnish researchers and epidemiologists with information vital for orthodontic treatment.[27] This approach may benefit the researchers to better understand the relationship between malocclusion and quality of life and will be also useful for health care providers in organizing health care (orthodontic treatment).

This study intended to investigate the impact of malocclusion on OHRQoL in adolescents by conducting a secondary analysis of the data available from the Pelotas 2004 birth cohort study.

Objectives

1) To demonstrate the characteristics of malocclusion among Brazilian adolescents;
2) To evaluate the role of malocclusion on OHRQoL, and
3) To assess whether the impact of malocclusion on OHRQoL among adolescents varied based on the severity levels of malocclusion.

METHODS

Pelotas is located in the South of Brazil, in the Rio Grande do Sul state, very close to Uruguay. A population-based birth cohort study was carried out in the urban city of Pelotas, Brazil, in the year 2004 (2004 PBCS), including all live births in the city. All mothers living in the urban area of Pelotas and their children born in maternity hospitals of the city of Pelotas (N = 4231) were eligible to participate in this study. The 2004 PBCS carried out full follow-up visits rather than sub-samples at the ages of 3, 12, 24 and 48 months. During the follow-ups, mothers were interviewed in the perinatal study with respect to their demographic, socio-economic and reproductive features, lifestyle, morbidity, health care utilization and breastfeeding practices. In 2009, the first oral health study (OHS09) was carried out. Children who were born between September and December in the year 2004 and were followed up at 4 years of age were invited to participate in the OHS09 (1,303 children). A questionnaire was given to the parents which included mothers and child's oral health behaviour, self-perception of the mothers and child's oral health and self-rated maternal oral health. Children were dentally examined in their homes, seated in a normal chair with the aid of artificial illumination (headlamp). Dental conditions such as dental caries (DMFS index), plaque, dental trauma, and malocclusion were investigated. Before the dental examination, examiners were trained and calibrated to perform dental examinations. During this process, eight dentists examined 100 pre-schoolchildren excluded from the sample. The second oral health study (OHS17) nested in the 2004 PBCS was carried out in 2017 and included all children (N = 1,129) who participated in the 2009 OHS. Participants were between 12 and 13 years of age and were investigated at the children's home regarding different oral health outcomes such as dental caries, malocclusion, dental trauma, plaque, oral mucosal lesions, fluorosis, dental erosion, and periodontal conditions. The key exposure variable for the current study was malocclusion in the permanent dentition collected in the second wave of the Pelotas Oral Health Study (OHS17). The oral examination to estimate malocclusion was carried out using dental aesthetic index (DAI) which is recommended by the WHO,[28] and the need for orthodontic treatment was obtained from this index. Malocclusion was evaluated according to the four different levels of orthodontic treatment need from the DAI index as the main exposure. In

terms of the need for definitive orthodontic treatment, DAI was made to classify into 4 categories 1. Normal malocclusion with a DAI score of ≤ 25; 2. Definite malocclusion with a score ranging between 26 - 30; 3. Severe malocclusion where the score ranged between 31 - 35 and 4. Handicapping malocclusion with a DAI score ≥ 36.[29] The outcome for the current study was oral health-related quality of life (OHRQoL) in the adolescence period analysed as a continuous variable. Data from OHS 17 regarding the quality of life was considered the outcome. The child perception questionnaire (CPQ$_{11 - 14}$) is designed to measure OHRQoL among children aged between 11 and 14 years. The question: "In the past 3 months, how often have you... (had / been)... because of your teeth / mouth?" is answered according to the following categories: never, once or twice, sometimes, often, and every - day or almost every day with scores ranging from 0 to 4, respectively. An overall score is also calculated relating to what had occurred in the last three months. Each child was asked to complete the ECOHIS and CPQ questionnaire just before the dental examination. Information on the subjects' parental schooling and family income at birth, access to orthodontic treatment, oral - health-related quality of life at childhood, and other dental conditions were considered potential confounders. In this present study, we used the National Economic Indicator (IEN), a wealth indicator that is less subject to temporal variability as it is based on aspects that don't change over short duration of time.

In the current study, need for orthodontic treatment was the main exposure. The dental aesthetic index (DAI), was applied which was measured using a mouth mirror and dental probe under a clinical set up at 12 years of age. DAI was categorized into 4 categories depending on the level of severity of the malocclusion. The index score between 0 - 25 is no malocclusion / no treatment required, 26 - 30 (mild / moderate) level of treatment needed, a score between 31 - 35 (severe malocclusion) there is need for treatment and ≥ 36 (handicapping malocclusion) where there is a definite need for treatment. Wealth indicator, maternal schooling at birth, sex, completed orthodontic treatment, DMFS, trauma, fluoride, gingivitis, plaque, fluoride, erosion at 12 years of age and ECOHIS are considered to be the potential confounders. The wealth indicator is nothing but the family income at birth in quintiles which is categorized into 5 categories with number 1 being the (lowest income) and 5 being the (highest income) category. Maternal schooling was collected as the number of completed years of mothers' schooling at childbirth and it was categorized into 4 categories as follows: 0 - 4, 5 - 8, 9 - 11 and ≥12 years. Subjects response to their orthodontic treatment completion was recorded as having had completed orthodontic treatment, orthodontic treatment not completed, and never has had at 12 years of age. The number of surfaces with decay, missing and filled surface of teeth among 12 - year - old adolescents were identified under a clinical setup using a dental chair, mouth mirror, dental probe and dental light. These scores were further categorized into 0 (no surfaces affected with decay / missing / filled), 1 - 4 and ≥ 5. Adolescents at 12 years of age affected with any dental conditions such as plaque,[30] gingivitis by the application of gingival bleeding index was proposed by Silness and Loe,[31] The scores were classified into 0,1,2,3 and 4 where score 0 indicated normal gingiva, score 1 indicated gingiva with mild inflammation / slight change in colour / slight oedema / no bleeding on probing, score 2 indicated gingiva with moderate inflammation / redness / oedema /

glazing and bleeding on probing, score 3 indicated gingiva with severe inflammation / marked redness and oedema / ulceration and tendency to spontaneous bleeding. Any sign of inflammation (scores 1 - 4) was considered the presence of gingivitis. Fluorosis was classified based on Dean Index characteristics.[32]

Dean's Index includes the categories questionable, mild, moderate / severe and corroded appearance of the tooth. Those areas of teeth with occasional white flecking and spotting of enamel were considered being questionable, whereas areas with white opacity involving more of the tooth surface were considered to be mild cases and pitting / brownish staining of the tooth surfaces were considered moderate / severe. Any level of trauma and erosion responses were noted down with the help of a questionnaire and the response given was either yes / no.

Statistical Analysis

Statistical analysis was performed using the Statistical Package for the Social Sciences (SPSS for Windows, version 22.0, SPSS Inc., and Chicago, IL, USA). Data were analysed using descriptive statistics (mean and standard deviation). After the descriptive statistics, linear regressions between the outcome and independent variables were performed to estimate the crude associations (beta coefficients and 95 % confidence intervals). Multivariable linear regression was performed to verify the impact of malocclusion on oral health-related quality of life (OHRQoL) of adolescents according to the following models: Model 2 adjusted model 1 for socioeconomic status, maternal schooling and sex, model 3 adjusted model 2 for ECOHIS and finally, the fully adjusted model 4, accounting for model 3 adjusted for DMFS other dental conditions and orthodontic treatment.

RESULTS

Study Selection and Characteristics

A total of 1129 children were investigated in 2009, and during the second follow up nearly one thousand (N = 996 children) were dentally assessed and interviewed at 12 years of age in 2017. Table 1 shows a high proportion of mothers who attended between 5 and 8 years of schooling (39.1 %) and approximately 10 % (10.4 %) of the mothers having 12 years or over of schooling. Slightly more than half of the samples were females (50.1 %). Nearly one-fifth of the sample was caries-free (63.3 %) while the majority (13.3 %) had 5 or more DMF surfaces.

Apart from dental caries, the dental condition with the highest prevalence was dental plaque (80.0 %), followed by gingival inflammation (51.7 %). Dental trauma (24.4 %) and fluorosis (22.9 %) showed similar prevalence. During adolescence, DAI had a borderline association with OHRQoL. Around (49.7 %) of children had a DAI score between 0 - 25 and with a score of ≥ 36 about 10.0 % of children were identified. An inverse association between the level of family wealth indicator and the OHRQoL indexes at 5 and 12 years of age was observed. The higher the wealth indicator the lower the negative impact on the child´s OHRQoL.

Children whose mothers attended school for 12 years or more had lower scores of the CPQ11 - 14 indexes than the

others. The higher the number of affected DMF surfaces the greater the impact on individual OHRQoL index in both ages. The presence of dental plaque was positively associated with the overall QoL index. Adolescents with an overall DAI score of 36 or over had greater CPQ11 - 14 scores than the others. (Table 1).

	Variables	Sample		ECOHIS		CPQ 11 - 14	
		N	%	mean	se	mean	se
Wealth indicator (quintiles) – birth	1 (lowest)	163	16.4	16.71	.803	25.90	.442
	2	143	14.4	16.58	.514	24.20	.933
	3	159	16.0	16.04	.473	24.68	.554
	4	159	16.0	16.01	.999	25.15	.987
	5 (highest)	152	15.3	15.24	.771	23.45	.931
	p-value			.000		.021	
Maternal schooling (completed years) – birth	0 – 4	111	11.2	16.37	.697	25.73	.200
	5 – 8	387	39.1	16.76	.907	25.42	.200
	9 – 11	368	37.1	15.68	.069	23.73	.512
	≥ 12	103	10.4	15.83	.763	23.04	.885
	p-value			.812		.153	
Sex	Male	495	49.9	16.14	.223	24.44	.893
	Female	496	50.1	16.22	.817	24.65	.851
	p-value			.767		.633	
Completed orthodontic treatment (12 yrs.)	Yes	55	5.5	15.04	.391	22.95	.417
	No	282	28.5	16.30	.289	24.86	.652
	Never had	466	47.0	16.26	.003	24.20	.718
	p-value			.194		.937	
DAI index (12 years)	0 – 25	493	49.7	16.08	.078	24.25	.732
	26 – 30	252	25.4	16.35	.436	24.30	.484
	31 – 35	138	13.9	16.17	.355	24.73	.247
	≥ 36	99	10.0	16.02	.192	26.26	.629
	p-value			.918		.018	
DMFS (number of surfaces) (12 yrs.)	0	627	63.3	15.87	.867	23.75	.819
	1 – 4	232	23.4	16.68	.103	24.88	.776
	≥ 5	132	13.3	16.78	.501	27.75	.014
	p-value			.004		.000	
Trauma (12 yrs.)	No	749	75.6	16.27	.156	24.56	.071
	Yes	242	24.4	15.89	.557	24.51	.221
	p-value			.231		.920	
Fluoride (12 yrs)	No	763	77.1	16.10	.973	24.64	.904
	Yes	227	22.9	16.47	.201	24.18	.743
	p-value			.242		.373	
Gingivitis (12 yrs)	No	478	48.2	16.28	.924	24.47	.331
	Yes	512	51.7	16.08	.119	24.61	.349
	p-value			.442		.748	
Plaque (12 yrs)	No	198	20.0	16.08	.481	23.27	.144
	Yes	793	80.0	16.21	.156	24.87	.007
	p-value			.698		.003	
Erosion (12 yrs)	No	887	89.5	16.11	.954	24.51	.839
	Yes	104	10.5	16.73	.566	24.90	.147
	p-value			.149		.576	

Table 1. Descriptive and Clinical Variables of Subjects with Mean EOHIS and CPQ11 - 14

Variables	DAI Normal / Minor Malocclusion N (%)	Definite Malocclusion N (%)	High Need of Treatment N (%)	Severe Malocclusion N (%)	p
	Wealth indicator (quintiles) – birth				.411
1 (lowest)	76 46.6 %	34 20.9 %	31 19.0 %	22 13.5 %	
2	62 44.9 %	39 28.3 %	21 15.2 %	16 11.6 %	
3	76 47.8 %	44 27.7 %	22 13.8 %	17 10.7 %	
4	84 53.2 %	42 26.6 %	19 12.0 %	13 8.2 %	
5 (highest)	81 53.3 %	43 28.3 %	15 9.9 %	13 8.6 %	
	Maternal schooling (completed years) – birth				.671
0 - 4	4 50.0 %	3 37.5 %	1 12.5 %	-	
5 - 8	49 47.6 %	25 24.3 %	20 19.4 %	9 8.7 %	
9 - 11	441 50.5 %	224 25.6 %	118 13.5 %	91 10.4 %	
≥ 12					
	Sex				.092
Male	228 46.3 %	132 26.8 %	79 16.1 %	53 10.8 %	
Female	266 54.0 %	120 24.3 %	60 12.2 %	47 9.5 %	
	Completed orthodontic treatment (12 yrs)				.609
Yes	147 51.9 %	71 25.1 %	38 13.4 %	27 9.5 %	
No	35 64.8 %	8 14.8 %	6 11.1 %	5 9.3 %	
Never had	14 48.3 %	8 27.6 %	5 17.2 %	2 6.9 %	
	DMFS (number of surfaces) (12 yrs)				.801
0	315 50.4 %	154 24.6 %	87 13.9 %	69 11.0 %	
1 - 4	118 51.8 %	60 26.3 %	31 13.6 %	19 8.3 %	
≥ 5	61 46.2 %	38 28.8 %	21 15.9 %	12 9.1 %	
	Trauma (12 yrs)				.462
No	380 51.1 %	189 25.4 %	98 13.2 %	77 10.3 %	
Yes	114 47.3 %	63 26.1 %	41 17.0 %	23 9.5 %	
Fluoride (12 yrs)					.210
No	381 50.2 %	190 25.0 %	103 13.6 %	85 11.2 %	
Yes	113 50.2 %	61 27.1 %	36 16.0 %	15 6.7 %	
	Gingivitis (12 yrs)				.333
No	254 53.1 %	114 23.8 %	63 13.2 %	47 9.8 %	
Yes	240 47.3 %	138 27.2 %	76 15.0 %	53 10.5 %	
Plaque (12 yrs)					.023
No	116 58.9 %	47 23.9 %	22 11.2 %	12 6.1 %	
Yes	378 48.0 %	205 26.0 %	117 14.8 %	88 11.2 %	
	Erosion (12 yrs)				.377
No	444 50.3 %	230 26.0 %	124 14.0 %	85 9.6 %	
Yes	50 49.0 %	22 21.6 %.	15 14.7 %	15 14.7 %	

Table 2. Association between the Dental Aesthetic Index (DAI) and the Independent Variables

		Model 1			Model 2			Model 3			Model 4		
		'B'	SE	P Value	'B'	SE	P	'B'	SE	P Value	'B'	SE	P
DAI	No treatment	-	-	-	-	-	-	-	-	-	-	-	-
	Minor malocclusion or normal occlusion	.021	.529	.969	.083	.527	.875	-.151	.532	.776	-.151	.532	.776
	Definite malocclusion / elective treatment	.451	.659	.494	.395	.657	.549	.314	.669	.639	.314	.669	.639
	Compulsory need for treatment	1.982	.754	.009	1.955	.750	.009	1.928	.749	.010	1.928	.749	.010
Wealth indicator (quintiles) – birth	1 (lowest) - ref	-	-	-	-	-	-	-	-	-	-	-	-
	2	-	-	-	-.614	.670	.359	-.522	.680	.443	-.520	.671	.439
	3	-	-	-	.310	.654	.636	.377	.664	.570	.388	.657	.555
	4	-	-	-	1.240	.673	.066	1.289	.684	.060	1.384	.676	.041
	5 (highest)	-	-	-	-.043	.737	.953	.299	.753	.692	.457	.753	.544
Maternal schooling (years at childbirth)	0 - 4 - ref	-	-	-	-	-	-	-	-	-	-	-	-
	5 - 8	-	-	-	-.057	.687	.934	-.268	.704	.703	.069	.698	.922
Sex	Male	-	-	-	.279	.435	.522	.233	.443	.599	.226	.440	.608
	Female - ref	-	-	-	-	-	-	-	-	-	-	-	-
		-	-	-	-	-	-	.145	.055	.009	.123	.055	.025
ECOHIS	1 - 4	-	-	-	-	-	-	-	-	-	1.078	.528	.041
	≥ 5	-	-	-	-	-	-	-	-	-	3.184	.685	.000
Plaque	No - ref	-	-	-	-	-	-	-	-	-	-	-	-
	Yes	-	-	-	-	-	-	-	-	-	.924	.550	.093
Orthodontic treatment	Yes - ref	-	-	-	-	-	-	-	-	-	-	-	-
	No	-	-	-	-	-	-	-	-	-	- 1.310	.993	.188
	Never had	-	-	-	-	-	-	-	-	-	-.749	.455	.100

Table 3. Multiple Linear Regression Analysis of the Relationship between DAI, Income, Maternal Schooling, Sex, DMFS, ECOHIS, Plaque and Orthodontic Treatment According to CPQ (as a Dependent Variable) in Adolescent's Age 12 Years

*OT = Orthodontic Treatment; Model 1: Dental Aesthetic Index (DAI); Model 2: DAI, income, maternal schooling and sex; Model 3: DAI, income, maternal schooling, sex and ECOHIS; Model 4: DAI, income, maternal schooling, sex, ECOHIS, Decay Missing and Filled surfaces of teeth (DMFS), Dental condition (Plaque) and Orthodontic treatment

Association between DAI and Independent Variables

It is displayed in Table 2. Only the presence of dental plaque was associated with the DAI index, with a significantly greater prevalence of severe malocclusion among those presenting plaque (11.2 %) than those without plaque (6.1 %).

Multivariable Linear Regression Analysis between CPQ11 - 14 and DAI

Table 3 represents the multivariable linear regression analysis between the CPQ11 - 14 indexes and the DAI index. Children with mandatory orthodontic treatment had greater scores of the CPQ11 - 14 indexes (Model 1). CPQ11 - 14 score was higher, on average, 1.928 (SE 0.749) units among those with mandatory orthodontic treatment when compared to those with normal occlusion. This result was found even after adjustment for all covariates. Other covariates that remained associated with lower scores of the CPQ11 - 14 indexes was maternal schooling at 9 - 11and ≥ 12 years when compared to those who attended school less than 5 years. Other variables like ECOHIS and DMFS with a score ranging between 1 - 4 and ≥ 5 was related with lower CPQ11 - 14 scores when compared to those whose DMFS score was equal to 0.

DISCUSSION

In the present study, adolescents with severe malocclusion, identified through the DAI score ≥ 36, had a greater chance of experiencing a negative impact on their oral health-related quality of life than their counterparts. This finding was observed regardless of the presence of other dental conditions and well-known confounders such as wealth indicators and maternal schooling.

The overall prevalence of severe malocclusion was 10.2 %, while slightly more than half of the participants had normal or minor malocclusions. Similar findings for severe malocclusion were reported among adolescents aged from 15 to 19 years from a different region in Brazil[33] however, it was lower than that indicated in other cities in the southern region of Brazil, where prevalence of 27.2 % [34] and 17.7 % for severe malocclusion[11] was found.

The difference in the results of the study could be due to variation in the age of the participants that comprised the samples. In our current study, we observed a high percentage of adolescents with normal / minor malocclusion followed by those with definite, high need for treatment and who require essential treatment were categorised as severe malocclusion.

Similar results with a high percentage of minor malocclusion (82.7 %) followed by those with a definite need for treatment, and with severe malocclusion (17.3 %) were observed among 12 - 15 year old school children in India, which used the same malocclusion index.[35]

Several studies have investigated the impact of malocclusion on the OHRQoL, among them, only two systematic reviews focused on children and adolescents.[36,37-39] A systematic review presented in 2014 concluded that the level of evidence was high, highlighting that severe malocclusions have negative effects on OHRQoL among children and adolescents especially in the aesthetic zone such as the presence of anterior crowding, midline diastema, overjet and deep - bite. Moreover, such malocclusions affect, predominantly, emotional and social well-being domains.[40] Interestingly, a study carried out in Brazil investigated the association between children and parents' views about their child's OHRQoL perception. The authors found that children and parents do not necessarily share the same views about the child OHRQoL, particularly how it impacts their social and emotional well–being.[37] Despite the evidence on the association between malocclusions and negative impact on OHRQoL, some studies such as in Zambia[41] observed an inverse association. Cultural differences and the age of the children could explain such differences in findings.[42]

Among all investigated independent variables, only the presence of dental plaque was significantly associated with severe malocclusion. This finding corroborates with other studies where children with the need of orthodontic treatment were three times more likely to have gingival bleeding and plaque than those without orthodontic treatment needs in India.[43] Visible plaque was also significantly associated with children without spacing in maxillary anterior teeth in Southern Brazil,[44] and with the presence of malocclusion in Brazil[44] and Malaysia.[45,46] Plaque is the main etiological factor for any periodontal disease, which is influenced by the host's immunological response.[47] A varied number of studies from various populations have reported that poor oral hygiene and the presence of visible plaque contribute to severe malocclusion and are very strong predictors for gingival inflammation[48] which further shows an adverse effect on OHRQoL.[49] The presence of certain types of malocclusion can make it difficult to clean the teeth which might contribute to the accumulation of plaque.

No association was found between sex and the negative impact on OHRQoL, which is also in agreement with the data reported in previous studies.[44,50,51] The results of our current study might be explained by the fact that children in the age group selected for the current study perceived the psychosocial effect of malocclusion.[51] The presence of dental plaque was significantly associated with a negative impact on OHRQoL, which is in agreement with the data reported in previous studies from Brazil and Malaysia. Another outcome associated with the negative impact of OHRQoL was the presence of dental caries. The greater the number of DMFS the stronger was the association. If the tooth decay is untreated it may cause difficulties in eating and sleeping that may impact child growth and is a leading cause of absence from both school and work. There are very few studies in which experience of caries was taken into consideration in the analysis of the association between malocclusion and OHRQoL, which gives an innovative approach to our study. Moreover, caries and tooth loss are the major predisposing factors for malocclusion both in primary and permanent dentition.[52]

An association was found between the level of education of mothers and OHRQoL. It is an important marker; thus, increase in child caries was seen associated with a negative impact on a child's quality of life. Moreover, the mean ECOHIS scores were significantly lower for mothers with the least educational attainment (ratio: 0.7; 95 % CI: 0.5,1.0)[6] In the field of oral health, it is always believed that maternal schooling, income levels and other dental conditions are associated with the overall quality of life among children and adolescents.

To the best of our knowledge, this is the first study that controls the analysis of the association between malocclusion in permanent dentition and OHRQoL for the level of quality of life in earlier stages of life. ECOHIS is a tool, which is widely used to investigate OHRQoL in childhood; it includes different domains and also describes the impact in the early stages. In the current study, adjusting the analyses for ECOHIS helped us to reinforce the idea that the negative impact on OHRQoL in adolescents is related to recent oral health conditions after childhood rather than a cumulative issue. The severe DAI category was associated with negative OHRQoL, independently of other oral health diseases and conditions and previous negative impact on the quality of life during childhood. Both ECOHIS and CPQ scales were strongly associated with each other.

This study makes a great contribution to academic literature as it is the first investigation that carried a secondary analysis using the Pelotas oral health study and provided such evidence in a sample of other Pelotas oral health follow up studies. It has been suggested that adolescents' oral and dental conditions affect the adolescents OHRQoL.[53] The results of our study revealed that severe malocclusion had a greater chance of impact on OHRQoL. To further achieve a more comprehensive analysis, it is recommended to conduct a multidisciplinary approach to reduce the negative impact on QoL. Moreover, the development of special oral health policies with a focus on those with severe malocclusion considering the adverse effect of a reduced QoL for future management of health and would be helpful to identify the disease progression.

The strengths of our current study are the inclusion of ECOHIS as a confounder, quality of data collection, the quality control of the interview-based assessments, the robust instrument used to investigate QoL and evaluation of a population-based sample of adults in a middle-income setting. The results showed a significant association between the impact of malocclusion on overall OHRQoL and this finding may be characteristic of the specific population of the particular geographic region from where the selection of children and adolescents took place. While concerning the negative impact of malocclusion on OHRQoL, it should be identified / analysed with utmost caution and it cannot be the same for the entire population in the same age group.

CONCLUSIONS

In conclusion, the impact of malocclusion on daily events among Brazilian adolescents was a common finding in our study. Some other important variables like gingival status, schooling of the fathers that possibly act during childhood which might be affecting the QoL were not included in our present study. These findings may not only contribute to the literature but may also furnish researchers and epidemiologists with information vital for orthodontic treatment and use to identify the community needs and help in the implementation of the treatment plan. Further studies need to be developed to clarify the most complex relationship between the impacts of malocclusion on QoL.

Limitations

The limitations of the present study are typical of the study design, specific population with specific cultural aspects and characteristics so that we cannot generalize the findings. There are many unmeasured confounders like other conditions that affect OHRQoL may exist and they were not taken into consideration. The percentage of losses of participants for follow-up could be an issue however the individuals located in 2015 were similar to the original cohort according to most of the baseline characteristics.

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