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Dental caries are more likely to impact on children's quality of life than malocclusion or traumatic dental injuries

ABSTRACT

Aim To measure the impact of dental caries, malocclusion, and traumatic dental injuries (TDI) on the oral health-related quality of life (OHRQoL) of Brazilian children. Study design: population-based cross-sectional study.

Methods A representative sample of 1,204 8-to-10-year-old children randomly selected from 19 public and private schools in Belo Horizonte (Brazil) was evaluated. The Decayed, Missing and Filled Teeth Index (DMFT), the Dental Aesthetic Index (DAI), and Andreasen's classification were used by two calibrated examiners to diagnose dental caries, malocclusion, and TDI, respectively. Children were clinically examined at school. The Brazilian version of the Child Perceptions Questionnaire for ages 8 to 10 years (CPQ₈₋₁₀) was used to assess the impact on OHRQoL.

Results There were statistically significant differences ($p < 0.001$) between groups (dental caries, malocclusion, and TDI) in all subscales and the CPQ₈₋₁₀ total score. The presence of dental caries alone and its association with

TDI and malocclusion were associated with all CPQ₈₋₁₀ subscales ($p < 0.05$). Statistics: the Poisson regression model with a robust variance estimator was utilised for the multivariate analysis. Adjusted prevalence ratios were obtained for the association between oral conditions and the total score on the CPQ₈₋₁₀ and its subscales.

Conclusion Dental caries seems to be the oral condition most commonly associated with a higher impact on the OHRQoL of Brazilian 8-to-10-year-olds.

Keywords Children; Dental caries; Malocclusion; Quality of life; Traumatic dental injuries

Introduction

The evaluation of the impact of oral conditions on children's oral health-related quality of life (OHRQoL) should be an essential component of oral health surveys [Bianco et al., 2010]. The assessment of OHRQoL plays a very important role in clinical practice in terms of identifying needs, selecting the best therapies, monitoring patients' progress, and helping clinicians understand the benefits obtained from the treatment of oral conditions [Antunes et al., 2013].

Studies using different designs have shown that oral conditions are associated with a negative impact on children's OHRQoL in different age groups [Martins-Júnior et al., 2012a; Sardenberg et al., 2013; Bendo et al., 2014a]. Studies addressing the impact on OHRQoL usually evaluate only one oral condition; however, it could be valuable to know the impact that each oral condition may have on children's OHRQoL.

Brazilian children have high prevalence of dental caries experience (56.5%), malocclusion (38.8%), and traumatic dental injury (20.5%) up to the age of 12 years [Brasil, 2015]. Studies have revealed that dental caries can influence functions that interfere with quality of life, such as eating, sleeping, talking, working, and having good general health [Edelstein, 2006; Do and Spencer, 2007, Moura-Leite et al., 2011]. Dentofacial aesthetics plays an important role in social interactions and psychological well-being, and malocclusions often cause children to feel embarrassed to smile [Marques et al., 2006]. Traumatic dental injury (TDI) has biological, emotional, and psychosocial consequences for young people [Cortes et al., 2002; Ramos-Jorge et al., 2007; Fakhruddin et al., 2009].

Given the paucity of studies on the impact of dental caries, malocclusion, and TDI on OHRQoL, the objective of this study was to assess the effect of: 1) each of these oral conditions; 2) the association of two of these conditions, and; 3) the three oral conditions on the OHRQoL of Brazilian 8-to-10-year-olds.

Materials and methods

Setting and sampling

A cross-sectional survey was carried out with a representative sample of 1,204 schoolchildren aged 8 to 10 years attending public and private elementary schools in the city of Belo Horizonte, Brazil. Belo Horizonte is divided into nine administrative districts. The schoolchildren were selected by multistage sampling. The sample size was calculated using an alpha of 0.05, a detectable error of 3%, and an expected prevalence of 75.0% for dental caries [Martins-Júnior et al., 2012a], 62.6% for malocclusion [Marques et al., 2006], and 21.0% for TDI [Cavalcanti et al., 2009]. The prevalence of malocclusion was chosen for sample size calculation because it was the most prevalent of the three conditions, being detected in 999 schoolchildren. A correction factor of 1.2 was applied to improve accuracy, as multistage sampling was used rather than random sampling [Kirkwood, 2003], increasing the sample size to 1,199. A rate of 20% was added to compensate for potential losses and, therefore, 1,439 schoolchildren were eventually included. To ensure representativeness, the sample was stratified according to administrative district and type of institution. The percentage distribution of 8-to-10-year-old schoolchildren in each administrative district was calculated based on the information provided by the local Board of Education. The distribution of participants was then determined by the proportion of this population in the respective school systems using the sampled data. The first stage consisted of randomly selected public and private elementary schools in each administrative district of Belo Horizonte. In the second stage, classes were randomly chosen from the selected schools.

Ethics

All procedures performed in this study involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1975 Helsinki Declaration, as revised in 2000.

The study was approved by the Human Research Ethics Committee of the Federal University of Minas Gerais. Parents/guardians and children read and signed an informed consent form prior to their participation in the study.

Training and calibration exercise

The examiners had previously participated in a training and calibration exercise for each clinical condition, conducted in a convenience sample school. Seventy schoolchildren (5% of the sample size and not part of the study population) participated in the calibration exercise. Inter-rater agreement was obtained (Kappa=0.71-1.00). Approximately 50 children were

reexamined after two weeks to assess intra-rater agreement (Kappa = 0.93-1.00).

Pilot study

The pilot study was carried out to test the methods and comprehension of the instruments. The results demonstrated that there was no need to change the proposed methodology.

Collection of clinical data

The Decayed, Missing and Filled Teeth Index (DMFT), the Dental Aesthetic Index (DAI), and Andreasen's classification were used by two calibrated examiners to diagnose dental caries [Who, 1997] malocclusion [Cons et al., 1986], and TDI [Andreasen et al., 2007], respectively. Dental caries was dichotomised as presence of one or more teeth with untreated dental caries or absence of untreated dental caries. Malocclusion was dichotomised as either present (DAI > 25) or absent (DAI ≤ 25). TDI was present if there was any sign of traumatic injury in one or more incisors. Dental examinations were carried out at schools during daytime hours. The examiners used appropriate equipment for protection against individual cross-infection, and all instruments were sterilised.

OHRQoL assessment

The Brazilian version of the Child Perceptions Questionnaire for ages 8 to 10 years (CPQ₈₋₁₀) was used [Martins et al., 2009] to assess the impact on OHRQoL. The CPQ₈₋₁₀ was designed exclusively for this age group. It has been proven to be valid and reliable for use with Brazilian children [Martins et al., 2009]. This instrument consists of 25 items distributed into four subscales: oral symptoms (5 items), functional limitations (5 items), emotional well-being (5 items), and social well-being (10 items). The items address the frequency of events in the past four weeks. A five-point rating scale was used, with the following options: never = 0; once/twice = 1; sometimes = 2; often = 3; and every day/almost every day = 4.

Collection of non-clinical data

The CPQ₈₋₁₀ scores were calculated by adding all the item scores. The total score ranged from 0 (no negative impact of oral condition on OHRQoL) to 100 (maximum negative impact of oral condition on OHRQoL).

Results

The Statistical Package for the Social Sciences, version 20.0 (SPSS Inc., Chicago, IL, USA), was used for the statistical analysis. The Kolmogorov-Smirnov test could not confirm the normality of the distribution. The Kruskal-Wallis and Mann-Whitney tests were used to assess the differences between groups. As

Variables	Oral symptoms	Functional limitations	Emotional well-being	Social well-being	Total Score
	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)
Kruskall-Wallis test					
No conditions	3.84 (3.07)	1.87 (2.72)	3.15 (4.08)	2.89 (4.63)	11.61 (11.88)
Dental caries	5.31 (3.52)	3.02 (3.59)	4.82 (4.55)	4.36 (5.42)	17.50 (14.31)
Malocclusion	4.14 (3.40)	2.37 (3.02)	4.83 (4.83)	4.18 (6.03)	15.49 (14.54)
Traumatic dental injuries	3.91 (3.16)	1.53 (2.13)	3.39 (4.14)	3.06 (4.20)	12.03 (11.52)
p-value	<0.001	<0.001	<0.001	<0.001	<0.001
Mann-Whitney test*					
No conditions/ dental caries	<0.001	<0.001	<0.001	<0.001	<0.001
No conditions/malocclusion	0.469	0.046	<0.001	0.004	0.001
No conditions/ traumatic injuries	0.859	0.616	0.449	0.370	0.441
Dental caries/ malocclusion	0.001	0.107	0.792	0.445	0.124
Dental caries/traumatic injuries	0.002	0.001	0.009	0.066	0.003
Malocclusion/traumatic injuries	0.759	0.068	0.021	0.255	0.096
Kruskall-Wallis test: $p < 0.05$, *Mann-Whitney test: Bonferroni corrections ($p < 0.008$)					

TABLE 1 Mean difference between independent variables and the total score of CPQ8-10 and its specific subscales (n=1,119).

the independent variables included four categories, it was necessary to perform multiple comparisons with Bonferroni corrections. The p values less than 0.008 were considered to be statistically significant. This p value resulted from 0.05/6.

The Poisson regression model with a robust variance estimator was used for the multivariate analysis. The adjusted prevalence ratios were obtained for the association between oral conditions and the total score on CPQ₈₋₁₀ and its specific subscales.

A total of 1,204 children were examined (44.7% boys and 55.3% girls) in the city of Belo Horizonte, Brazil, representing 8-to-10-year-old children (28.2% 8 year-olds, 35.5% 9 year-olds, and 36.3% 10 year-olds). Of the 1,204 children, 57.7% (695 children) did not have any oral health conditions. Of the 509 children with some oral problem, 424 (83.30%) presented with only one condition, 78 (15.32%) had two conditions, and only seven children (1.38%) presented with dental caries, malocclusion, and TDI. Dental caries was the most prevalent oral condition. Of the total sample, 23.1% of the children (n=278) presented with dental caries, either alone or associated with another oral condition; 199 children (16.52%) presented with malocclusion, either alone or associated with another oral condition; and 124 children (10.3%) presented with TDI, either alone or associated with another oral condition.

There was statistically significant difference ($p < 0.001$) between the groups in all subscales and the CPQ₈₋₁₀ total score (Table 1). Children with dental caries presented higher scores compared with those with no oral conditions in all subscales and CPQ₈₋₁₀

total score ($p < 0.001$). Children with malocclusion had higher scores than those without any oral condition on the subscales "Emotional well-being" ($p < 0.001$) and "Social well-being" ($p = 0.004$) and in CPQ₈₋₁₀ total score ($p = 0.001$). There was no statistical difference ($p > 0.008$) when TDI and no oral conditions were compared (Table 1).

Children with dental caries were statistically different from children with malocclusion only on the subscale "Oral symptoms" ($p = 0.001$) and from children with TDI on the subscales "Oral symptoms" ($p = 0.002$) and "Functional limitations" ($p = 0.001$) and in CPQ₈₋₁₀ total score ($p = 0.003$).

In the multivariate Poisson regression model, children with dental caries were 1.51-fold (95%CI:1.32 to 1.73; $p < 0.001$) more likely to experience a high impact on their OHRQoL (total score) than those without any oral condition, and children with malocclusion were 1.33-fold (95%CI:1.12 to 1.59; $p = 0.001$) more likely to experience a high impact on their OHRQoL than those without any oral health problems (Table 2).

Children who presented with dental caries associated with TDI, as well as dental caries associated with malocclusion, were more likely to experience a high negative impact on their OHRQoL, as shown by the total score, than those without any oral condition (Table 2).

Children with the three oral conditions were 2.01-fold (95%CI:1.04 to 3.86; $p = 0.037$) more likely to experience a high negative impact on their OHRQoL (total score) than those without any oral health problems (Table 2).

The presence of dental caries only and its association

Variables	Oral symptoms	Functional limitations	Emotional well-being	Social well-being	Total Score
	Robust RR (95%CI)	Robust RR (95%CI)	Robust RR (95%CI)	Robust RR (95%CI)	Robust RR (95%CI)
	p-value	p-value	p-value	p-value	p-value
Oral condition					
No conditions (n=695)	1	1	1	1	1
Dental caries (DC)	1.38 (1.24-1.54)	1.62 (1.33-1.96)	1.53 (1.30-1.80)	1.51 (1.23-1.86)	1.51 (1.32-1.73)
(n=206)	<0.001	<0.001	<0.001	<0.001	<0.001
Traumatic dental injuries	1.02 (0.85-1.23)	0.82 (0.59-1.13)	1.08 (0.81-1.43)	1.06 (0.77-1.46)	1.04 (0.83-1.30)
(TDI) (n=79)	0.850	0.225	0.604	0.725	0.756
Malocclusion (M)	1.08 (0.93-1.25)	1.27 (1.00-1.61)	1.53 (1.27-1.86)	1.45 (1.11-1.90)	1.33 (1.12-1.59)
(n=139)	0.329	0.049	<0.001	0.007	0.001
DC + TDI	1.52 (1.17-1.97)	1.82 (1.11-2.98)	1.89 (1.33-2.70)	1.69 (1.06-2.70)	1.73 (1.25-2.41)
(n=25)	0.002	0.018	<0.001	0.029	0.001
DC + M	1.49 (1.17-1.90)	1.76 (1.21-2.57)	2.05 (1.59-2.64)	1.96 (1.34-2.86)	1.82 (1.42-2.33)
(n=40)	0.001	0.003	<0.001	0.001	<0.001
TDI + M	1.32 (1.00-1.74)	2.14 (1.33-3.44)	2.32 (1.53-3.52)	1.49 (0.82-2.71)	1.85 (1.35-2.54)
(n=13)	0.048	0.002	<0.001	0.191	<0.001
DC+M+TDI	1.60 (0.94-2.71)	2.37 (1.05-5.33)	2.13 (1.15-3.98)	2.08 (0.74-5.81)	2.01 (1.04-3.86)
(n=7)	0.082	0.037	0.017	0.164	0.037
Robust RR: robust rate ratio; 95%CI: confidence interval; Calculated by Poisson regression analysis with robust variance; results in bold type are significant at the 5% level; Note: DC=dental caries, TDI=traumatic dental injury, M=malocclusion					

TABLE 2 Multivariate Poisson regression for association between oral condition and CPQ8-10 total scores and its specific subscales (n=1,204).

with TDI and malocclusion were associated with all CPQ₈₋₁₀ subscales (p<0.05) (Table 2).

Discussion

Dental caries was the most prevalent oral condition in this study. Dental caries alone or associated with another condition had a negative impact on children's OHRQoL. Children with only dental caries presented higher scores compared with those with no oral conditions on all subscales and CPQ₈₋₁₀ total score; furthermore, children with dental caries associated with malocclusion or TDI were more prone to having a negative impact on their OHRQoL, showing that dental caries has significant influence on functions that interfere with children's quality of life [Edelstein, 2006; Do and Spencer, 2007; Moura-Leite et al., 2009].

Studies have shown that dental caries can influence children's OHRQoL [Goursand et al., 2008; Torres et al., 2009, Foster Page et al., 2012], including a study with children in the same age group (8-10 years old) [Martins-Júnior et al., 2012b]. However, studies that compare the impact of different oral conditions on 8-to-10-year-old children's OHRQoL are scarce, and this

is the most relevant aspect of the present study.

Children with malocclusion had higher scores than those without any oral condition on the subscales "Emotional well-being" and "Social well-being" and in CPQ₈₋₁₀ total score. These results are probably due to the fact that DAI is an index that assesses changes in anterior teeth, which are more closely related to esthetics. Studies with children in the same age group showed that malocclusion (particularly in the anterior region) may require orthodontic treatment for improvement of oral health, dental functions, and aesthetics, which eventually ameliorates OHRQoL [Martins-Júnior et al., 2012a; Sardenberg et al., 2013].

The children with TDI did not show statistically significant difference on the CPQ₈₋₁₀ subscales or in general when compared with those without oral conditions, probably because enamel fracture was the major finding. Fractures involving only enamel are not perceived as problematic by individuals or by their families [Robson et al., 2009; Scarpelli et al., 2013; Bendo et al., 2014a]. Some studies demonstrated that more severe types of TDI, such as dentin and/or pulp fracture, were associated with children's and adolescents' OHRQoL [Bendo et al., 2014b; Abanto et al., 2015].

All clinical examinations were performed at schools. The diagnosis was made by visual dental examination alone. Both dental caries and TDI may have been underestimated because of the lack of radiographic examination. This may be a limitation of this study; however, this diagnostic procedure allowed having a large population-based sample that epidemiologically represents 8-to-10-year-old children from the city of Belo Horizonte.

Dental caries is the oral condition most frequently associated with all aspects of OHRQoL in Brazilian 8-to-10-year-old children. This information should be made largely available so that this preventable disease, can be priority in public health policies and preventive measures are carried out in the child population.

Conclusion

Despite the fact that malocclusion seems to affect mainly children's emotional and social well-being, dental caries is still the oral condition most commonly associated with all aspects of OHRQoL in Brazilian 8-to-10-year-old children.

Authors' contributions

MTM, FS, CB, SMP, MPV and IAP conceptualized the rationale and designed the study. MTM, FS and CB contributed to the collection of data, statistical analysis and interpretation of the data. MTM, SMP, MPV and IAP conducted the literature review and drafted the manuscript. All authors read and approved the final manuscript.

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