Case-control study examining the impact of oral health problems on the quality of life of the families of preschoolers

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Abstract: The aim of this study was to evaluate the impact of dental caries, traumatic dental injuries (TDI), toothaches, and malocclusion on the oral health-related quality of life (OHRQoL) of the families of Brazilian preschool children. A population-based, matched case-control study involving 415 pre-schoolers aged 3–5 years was conducted. The case (impact on OHRQoL) and control groups (no impact on OHRQoL) were matched for age, gender, and family income at an 1:4 ratio. Impact on the OHRQoL of a family was assessed using the Brazilian version of the Early Childhood Oral Health Impact Scale (B-ECOHIS). Dental caries, TDI, and malocclusion were diagnosed by three calibrated dentists (Kappa: 0.85–0.90). Data analysis involved descriptive statistics and conditional logistic regression analysis (p ≤ 0.05; 95%CI). There were no differences between the cases and controls regarding age, gender, and family income (p > 0.05). The most frequent responses on the B-ECOHIS among cases were "felt guilty" (68.6%) and "been upset" (48.2%). The following variables were significantly associated with negative impacts on family OHRQoL (cases): caries severity (OR = 6.680; 95%CI = 2.731–16.349), a history of toothache (OR = 2.666; 95%CI = 1.492–4.765), parental rating of the child's oral health as poor (OR: 1.973; 95%CI = 1.072–3.634), and parent's/caregiver's age (OR = 2.936; 95%CI = 1.077–3.478). Anterior open bite was positively associated with OHRQoL (OR = 4.050; 95%CI = 1.333–12.314). Caries severity, a history of toothache, parental rating of the child's oral health as poor, and younger parents/caregivers were associated with impact on the OHRQoL of the families of preschoolers.

Keywords: Case-Control Studies; Dental Caries; Family Health; Quality of Life; Tooth Injuries.

Introduction

Parents/caregivers play a central role in ensuring the wellbeing of young children and are usually responsible for making decisions regarding matters affecting their child's health.[1,2] Thus, it is important to assess the impact of oral health issues in children on the quality of life of their families because illness and injury can affect the emotional wellbeing of families and, consequently, the child's use of dental services and the promotion of their oral health.[1,3,4]

Investigations have shown that oral health problems such as dental caries, traumatic dental injury (TDI), toothache, and malocclusion in children can have negative consequences on the family, such as feelings of guilt, irritation, financial problems, and loss of time and workdays for parents/caregivers.[5,6,7,8] However, most of these studies jointly evaluated impacts on the child and family [9,10] or focused only on specific consequences such as parental guilt.[7,8] A focused examination of the impact on family would contribute to a deeper understanding of this issue and also support health interventions. Moreover, a majority of the studies examining this issue employ a cross-sectional design, which does not allow inference of causality.[11] Conversely, case-control studies allow estimation of the strength of the association between an event and risk factors, and matched case-control groups allow us to control confounding variables and also result in a smaller sample size that enhances the precision and power of the study.[12] To date, no matched case-control study has focused on factors associated with the impact of oral health problems in preschool children on the quality of life of their families.

The aim of the present matched case-control study is to evaluate the impact of dental caries, TDI, toothache, and malocclusion on the oral health-related quality of life (OHRQoL) of the families of Brazilian preschool children.

Methodology

This study was conducted in accordance with the Declaration of Helsinki, and was independently reviewed and approved by the Human Research Ethics Committee of the State University of Paraiba (Brazil) (protocol number 0046.0.133.000-11). Parents/guardians received information regarding the objectives of the study and also provided written informed consent.

Eligibility Criteria

This study included children aged three to five years enrolled in public or private preschools or day care centers, who did not suffer from any systematic diseases (based on the parents/caregiver's report), and were accompanied by a parent/caregiver who spoke Brazilian Portuguese. The exclusion criteria

were four maxillary incisors lost due to caries or physiological exfoliation as this could compromise a clinical diagnosis of TDI.

Sample Characteristics and Study Design

The study included a population-based, matched case-control sample consisting of 415 preschoolers enrolled at public and private preschools in the city of Campina Grande, Brazil. This study was nested in a previous cross-sectional investigation that involved 843 children of the same age randomly selected from a representative sample using a two-phase random sampling strategy.[13] Campina Grande is an industrialised city located in northeast Brazil and is divided into six administrative districts with a mean monthly income of approximately US$ 110 per capita and a Human Development Index of 0.72.[14]

The software Epi Info 6.04 (Centers for Disease Control and Prevention, Atlanta, GA, USA) was used to determine the minimum sample size needed for this case-control study. The following parameters were employed: power of 80.0%, standard error of 5.0%, and estimated 54.0% and 37.5% prevalence rates of caries in the case and control groups, respectively. These characteristics were determined in a pilot study. Guidelines for sample size calculation have established that using a 50% prevalence rate in the formula yields the maximum value of n, representing a sample large enough for the desired reliability and interval width.[15,16] Thus, the 54% prevalence rate used in the present study yielded a sample large enough to investigate the three oral conditions under study (dental caries, TDI and malocclusion). Considering four controls for each case, the minimum sample size to satisfy the requirements was 83 cases and 332 controls.

Selection of Cases and Controls

The Early Childhood Oral Health Impact Scale (ECOHIS) is an assessment tool designed to evaluate the impact of oral conditions on the OHRQoL of children aged two to five years and their families.[2] This questionnaire has been translated into Portuguese and validated for use on Brazilian populations (B-ECOHIS),[17,18,19] and has been employed in several previous studies.[10,17,20] It is a proxy measure that uses the reports of parents/caregivers and is divided into

two sections (Child Impact and Family Impact). Since the aim was to evaluate the impact of oral health problems on the family OHRQoL, the Child Impact Section was not used in the present study. The Family Impact Section has four items distributed over two domains: parental distress (two items) and family function (two items). Each item has six response options: never, hardly ever, occasionally, often, very often, and do not know.

Sample selection was carried out by two researchers (RTF and MCG). Of the original 843 children, 14 were excluded for having one or more "do not know" responses on the Family Impact Section of the B-ECOHIS and 92 were excluded for having missing information on independent variables. Of the remaining 737 children, 187 (25.4%) who exhibited impact on OHRQoL were considered eligible to be selected for the case group, while 550 (74.6%) who exhibited no impact on OHRQoL were considered eligible for the control group. The outcome variable "impact on family OHRQoL" was used to define cases and controls. Children with B-ECOHIS items for which responses were "occasionally" (score 2), "often" (score 3), or "very often" (score 4) on at least one question were categorised as having a negative impact on OHRQoL (case group), whereas those with responses of "never" (score 0) or "hardly ever" (score 1) for all items were categorised as having a non-negative impact on OHRQoL (control group) (Table 1).[18] Cases and controls were matched by age, gender, and monthly household income (categorised based on the monthly minimum salary of US$312.50 in Brazil) at a 1:4 ratio.

To preserve the representativeness of the data, the selection of children for the case and control groups was performed maintaining the proportion of children in each region (6 districts within the city limits plus surrounding rural areas) of the city of Campina Grande.[13]

Training and Calibration Exercise

The training and calibration exercise consisted of two steps (theoretical and clinical). The theoretical step involved a discussion of the criteria for the diagnosis of dental caries, TDI, malocclusion and an analysis of photographs. A specialist in pediatric dentistry (gold standard in this theoretical framework) coordinated this step, instructing three general dentists on how to perform the examination. The clinical step was performed at a randomly selected preschool that was not part of the main sample. Each dentist examined 50 previously selected preschool children, aged three to five years, from the main sample. Data analysis involved calculation of Cohen's Kappa coefficients on a tooth-by-tooth basis. Inter-examiner agreement was tested by comparing each examiner to the gold standard (K = 0.83 to 0.88). After a seven-day interval, the examinations were performed a second time for the determination of intra-examiner agreement (K = 0.85 to 0.90). As the Kappa coefficients were very good,[21] the examiners were considered capable of performing the epidemiological study.

Table 1. Distribution of responses to Brazilian version of Early Childhood Oral Health Impact Scale (B-ECOHIS) among preschool children in the case and control groups.

B-ECOHIS	Case group (n = 83)		Control group (n = 332)	
Domains, Items	Never or hardly ever	Occasionally, often, or very often	Never or hardly ever	Occasionally, often, or very often
	n (%)			
Family Impact				
Parental distress domain				
Been upset	43 (51.8)	40 (48.2)	332 (100.0)	0 (0)
Felt guilty	26 (31.3)	57 (68.6)	332 (100.0)	0 (0)
Family function domain				
Taken time off work	65 (78.3)	18 (21.7)	332 (100.0)	0 (0)
Financial impact	72 (86.7)	11 (13.3)	332 (100.0)	0 (0)

Pilot Study

A pilot study was performed to test the methodology and comprehension of the questionnaires. The children in the pilot study (n = 40) were not included in the main sample. As there were no misunderstandings regarding the questionnaires or the methodology, no changes to the data collection process were deemed necessary.

Non-Clinical Data Collection

Non-clinical data were acquired through administration of the B-ECOHIS as well as questionnaires collecting socio-demographic and child health data. Monthly household income was collected in crude value and then dichotomized by the median (up to one and more than one Brazilian minimum wage). All questionnaires were filled out by the parents/caregivers and returned to the researchers.

The following socio-demographic variables were analysed: parent/guardian's age, mother's schooling, and type of preschool (public or private). The following child health data were analysed: history of toothache, history of dental visits, and parent/caregivers perceptions regarding their child's general and oral health. The latter item was analysed based on answers to the following question: In general, how would you describe your child's general health/oral health? The response options were 1) very good, 2) good, 3) fair, 4) poor, and 5) very poor. For statistical purposes, these answers were dichotomised as good (codes 1 and 2) and poor (codes 3, 4 and 5).[10]

Clinical Data Collection

The clinical examination was carried out at the preschools after the caregivers had returned the questionnaires and signed statements of informed consent and was performed by three dentists who had undergone the training and calibration exercise. Prior to the exam, each child received a kit containing a toothbrush, toothpaste, and dental floss to remove bacterial plaque from the teeth and facilitate diagnosis. The examinations were performed with the child seated in front of the examiner and illuminated by a portable lamp positioned on the examiner's head (Petzl Zoom head lamp, Petzl America, Clearfield, UT, USA).

The dentists used individual protection equipment, a sterilised mouth mirror (PRISMA®, São Paulo, SP, Brazil), sterilised Williams probe (WHO-621, Trinity®, Campo Mourão, PA, Brazil), and gauze to dry the teeth.

Dental caries were diagnosed using the International Caries Detection and Assessment System (ICDAS II) [22] which is a scoring system ranging from 0 (absence of dental caries) to 6. Due to the epidemiological nature of the present study, code 1 was not used as drying of the teeth was performed with gauze rather than compressed air. Code 2 was used for white spots, and codes ≥ 3 represented increasing degrees of cavitation. For statistical purposes, dental caries was dichotomised as absent (code 0) or present (code ≥ 2) (24). Caries severity was also considered in the evaluation of the impact of dental caries on OHRQoL. This variable was categorised into no cavitated lesions and/or with white spots, low severity (up to 5 cavitated lesions), and high severity (6 or more cavitated lesions).

A diagnosis of TDI included enamel fracture, enamel + dentine fracture, complicated crown fracture, extrusive luxation, lateral luxation, intrusive luxation, and avulsion.[23] A visual inspection for tooth colouration was also performed, and a diagnosis of TDI was recorded if any type of TDI or tooth discolouration was observed.

A diagnosis of malocclusion was made if at least one of the following conditions were observed: increased overbite (> 2 mm), increased overjet (> 2 mm), anterior open bite, and anterior crossbite.[24,25] Following examination, a fluoridated varnish was applied to the teeth and children with dental caries or other dental needs were sent for treatment.

Statistical Analysis

Data organisation and statistical analyses were performed using the Statistical Package for Social Sciences (SPSS for Windows, version 21.0, IBM Inc, Amonk, NY, USA). Frequency distributions were used to characterise the sample and demonstrate the distribution of the B-ECOHIS items. Impact on OHRQoL was classified as 'no' for responses of "never" and "hardly ever" or "yes" for responses of

"occasionally," "often," and "very often."[2] The level of significance was set at 5% (p < 0.05). Explanatory variables with a p-value ≤ 0.20 in the bivariate analysis were incorporated into the conditional logistic regression model. Unadjusted and multiple conditional logistic regressions were performed using the backward stepwise method. Effect sizes (η[2]) were calculated for variables that remained in the final logistic regression model.

Results

No statistically significant differences in the frequency distribution of variables used for matching (gender, age and monthly family income; p > 0.05) were observed between the groups. No participants were excluded from the study for lack of cooperation during the clinical exam.

Table 1 presents the responses of the B-ECOHIS questions (Family Impact Section) for the case and control groups. In the case group, the most prevalent items affecting the family's quality of life were related to feeling guilty (68.6%) and being upset (48.2%).

In the final conditional logistic regression model, caries severity, a history of tooth pain, parent's/caregiver's age, and parent's/caregiver's perception of the child's oral health were associated with a negative impact on the family's OHRQoL. The presence of anterior open bite was a protective factor for family impact (Table 2).

Discussion

The importance of this investigation lies in the fact that it is the first case-control study to jointly investigate the impact of dental caries, toothache, TDI, and malocclusion on the quality of life of the families of preschoolers. Previous case-control studies have investigated the role of oral health problems on OHRQoL.[26,27,28] However, these studies focused on older children/adolescents[26,27,28] and defined cases and controls based on clinical conditions (TDI and malocclusion).[26,27] As the aim or our study was to investigate the influence of oral conditions on family OHRQoL (outcome variable), we classified groups based on the presence (cases) or absence (controls) of a negative family impact.

A high severity of caries was more frequent among cases. As expected, the final model showed that families with children presenting six or more carious lesions (high severity) were approximately seven times more likely to experience impact on their quality of life, in accordance with previous cross-sectional Brazilian studies[5,6,7,13,20]. This may stem from the fact that the progression of caries implies more complicated treatment, which can result in the loss of work days for parents and financial problems for the family.[2,5,6] Additionally, caries severity often results in unsightly appearance, which may concern parents/caregivers with regard to opportunities in the child's future life.[6] Severe caries can also lead to dental pain[29] which is associated with family impact, as demonstrated by our findings and previous cross-sectional investigations.[8,13] This may have occurred because parents may feel guilty and fear being blamed for their children's oral problems[7,8,30] or because the child may require extra attention to relieve discomfort, which can cause parental distress.[6] Indeed, parents/caregivers of children in the case group reported feelings of guilt and being upset.

The control group had a significantly higher frequency of anterior open bite (AOB) when compared to the case group. The present case-control study is the first investigation to show that the presence of AOB is a protective factor for impact on the family's quality of life. The literature is clear about the causal pathway between occlusal traits such as AOB and non-nutritive habits like thumb and pacifier sucking.[30] Given that such oral habits provide comfort and satisfaction and help the child calm down,[32] children with such habits, and thus with AOB, tend not to distress their parents, thereby explaining the absence of impact. Moreover, parents may not perceive malocclusion in primary teeth (children were 3–5 years old) as an oral problem. Other possible explanations rely on the fact that parents may think that malocclusion is hereditary,[7] not perceiving it as a real problem in this age group. This may contribute to parents not seeking treatment, thus avoiding expenditures as well as the loss of time.

Parental age was unevenly distributed among cases and controls. Parents younger than thirty years of age had a three-fold greater chance of experiencing impact on their OHRQoL than their counterparts. This

Table 2. Conditional logistic regression analysis and effect sizes of independent variables in study groups.

Independent variables	Group		p-value[*]	Unadjusted	p-value[**]	Adjusted	η²
	Case (n = 83)	Control (n = 332)					
	n (%)	n (%)		OR (95% CI)		OR (95% CI)	
Dental Caries							
Absent	15 (9.6)	141 (90.4)	< 0.001	1	-	-	-
Present	68 (26.3)	191 (73.7)	-	3.347 (1.837–6.098)	-	-	-
Caries Severity							
Caries free	21 (8.8)	219 (91.3)	-	1	-	-	-
Low severity	37 (27.6)	97 (72.4)	< 0.001	3.978 (2.213–7.150)	0.002	2.720 (1.450–5.100)	0.395
High severity	25 (61.0)	16 (39.0)	< 0.001	16.296 (7.538–35.223)	< 0.001	6.680 (2.731–16.349)	
TDI							
Absent	58 (20.1)	230 (79.9)	0.915	1	-	-	-
Present	25 (19.7)	102 (80.3)	-	0.972 (0.576–1.641)	-	-	-
Type of TDI							
Enamel fracture without trauma	71 (20,1)	282 (79.9)	0.978	1	-	-	-
Enamel + dentine fracture	3 (16.3)	15 (83.3)	0.722	0.794 (0.224–2.819)	-	-	-
Avulsion and/or luxation	1 (16.7)	5 (83.3)	0.835	0.794 (0.091–6.907)	-	-	-
Discolouration	8 (21.1)	30 (78.9)	0.891	1.059 (0.465–2.410)	-	-	-
Malocclusion							
Absent	59 (26.6)	163 (73.4)	< 0.001	1	-	-	-
Present	24 (12.4)	169 (87.6)	-	2.549 (1.514–4.292)	-	-	-
Anterior Crossbite							
Absent	82 (20.0)	329 (80.0)	0.802	1	-	-	-
Present	1 (25.0)	3 (75.0)	-	1.337 (0.137–13.024)	-	-	-
Anterior open bite							
Present	4 (6.6)	57 (93.4)	0.000	1	-	1	
Absent	79 (22.3)	275 (77.7)	-	4.094 (1.441–11.631)	0.014	4.050(1.333–12.314)	0.140
Increased Overjet							
Present	16 (13.9)	99 (86.1)	0.057	1	-	-	-
Absent	67 (22.3)	233(77.7)	-	1.779 (0.982–3.222)	-	-	-
Increased Overbite							
Present	7 (10.8)	58(89.2)	0.048	1	-	-	-
Absent	76 (21.7)	274(78.3)		2.298 (1.008–5.241)	-	-	-
Type of Preschool							
Public	48 (21.0)	181(79.0)	0.587	1	-	-	-
Private	35 (18.8)	151(81.2)	-	0.874 (0.537–1.421)	-	-	-
Parent/Caregiver age							
> 30 years	24 (12.4)	169(87.6)	< 0.001	1	0.027	1	-
≤ 30 years	59 (26.6)	163(73.4)	-	2.549 (1.514–4.292)	-	2.936 (1.077–3.478)	0.176
Mother's schooling							
> 8 years	49 (19.8)	198(80.2)	0.920	1	-	-	-
≤ 8 years	34 (20.2)	134(79.8)	-	1.025 (0.629–1.672)	-	-	-
Perception of general health							
Good	62 (18.0)	282(82.0)	0.028	1	-	-	-
Poor	21 (29.6)	50(70.4)	-	1.910 (1.071–3.409)	-	-	-
Perception of oral health							
Good	44 (14.1)	267(85.9)	< 0.001	1	0.029	1	
Poor	39 (37.5)	65(62.5)	-	3.641 (2.188–6.058)	-	1.973(1.072–3.634)	0.253
History of dental visit							
No	51 (16.8)	252(83.8)	0.009	1	-	-	-
Yes	32 (28.6)	80(71.4)	-	1.976 (1.189–3.287)	-	-	-
History of tooth pain							
No	38 (12.7)	261(87.3)	< 0.001	1	0.001	1	-
Yes	45 (38.8)	71(61.2)	-	4.353 (2.627–7.215)	-	2.666 (1.492–4.765)	0.293

[*]Unadjusted conditional logistic regression analysis; [**]Variables incorporated in multivariate model (p < 0.20): dental caries, caries severity, malocclusion, anterior open bite, increased overbite, increased overjet, parent's/caregiver's age, parent's/caregiver's perception of child's general health, parent's/caregiver's perception of child's oral health, history of dental visit, and history of tooth pain

association has been described in previous studies[10,33] as well as in a systematic review of the literature.[34] Younger parents/caregivers may have less professional stability [35] or less experience in taking care of their children, which can contribute to feelings of insecurity.[17] In this context, early counseling programs targeting this population can empower parents regarding this issue [36] and may help reduce the occurrence of these feelings.

Parents/caregivers who rated their child's oral health as "poor" were more likely to experience an impact on quality of life, which is consistent with data reported in previous cross-sectional studies.[8,13,37] Poorer perceptions of the child's oral health have been associated with the presence of tooth decay, low parental schooling, low household income, and feelings of guilt.[1,8,37] Such perceptions are also a strong indicator of the use of dental care services.[1,38] Therefore, investigating this issue is important for clinicians as it may enable them to improve children's oral health and quality of life.[5]

TDI did not exert an impact on the OHRQoL of the families, as there were no statistically significant differences in the distribution of this condition among cases and controls. The literature offers divergent findings on this issue,[10,13,39] but there is a tendency for only severe injuries such as fractures involving the pulp, avulsion, and/or luxation to be predictors of negative impact on a family's quality of life.[13,40] The greater frequency of enamel fractures in the children included in the present study may explain the lack of an association.

This study is limited by its retrospective nature, and recall bias may have influenced the parents'/caregivers' responses. However, besides its original design,

the 1:4 ratio used to pair cases and controls may be considered a strength as it allowed a bigger sample size, therefore increasing the accuracy and statistical power of the study.[12] Other strengths of this investigation include the use of a validated measure and the sampling process. Children were randomly selected from a representative sample of public and private preschools proportionally selected from all the administrative districts of the city of Campina Grande. Thus, we cautiously recommend the extrapolation of these findings to the population.

Our results strengthen the evidence that children's oral health problems reverberate beyond their clinical aspects. Improving access to dental care may prevent disease progression, thereby reducing family consequences and benefiting the state by reducing health costs and loss of productivity.

Conclusion

High caries severity, toothache, parental rating of the child's oral health as poor, and younger parents/caregivers were associated with a negative impact on the family's quality of life. Anterior open bite was a protective factor for family impact.

Acknowledgments

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