Risk indicators of untreated dental caries incidence among preschoolers: a prospective longitudinal study

Raquel Gonçalves VIEIRA-ANDRADE[(a)]
Isabela Almeida PORDEUS[(a)]
Maria Letícia RAMOS-JORGE[(b)]
Clarissa Lopes DRUMOND[(a)]
Luíza Costa SILVA-FREIRE[(a)]
Joana RAMOS-JORGE[(a)]
Saul Martins PAIVA[(a)]

[(a)]Universidade Federal de Minas Gerais – UFMG, School of Dentistry, Department of Oral Health of Children and Adolescents, Belo Horizonte, MG, Brazil.

[(b)]Universidade Federal dos Vales do Jequitinhonha e Mucuri – UFVJM, School of Dentistry, Department of Dentistry, Diamantina, MG, Brazil.

Corresponding Author:
Raquel Gonçalves Vieira-Andrade
E-mail: raquelvieira.andrade@gmail.com

Abstract: The aim of the present study was to evaluate the influence of socioeconomic factors, oral conditions and the impact of OHRQoL as possible risk indicators related to the incidence of untreated dental caries in preschool children two years after an initial examination. A prospective longitudinal study was performed with a sample of 288 preschool children allocated to two groups at baseline (T0): caries free (n = 144) and with untreated dental caries (n = 144). Untreated dental caries was determined through clinical examinations performed by a calibrated dentist at T0 (Kappa > 0,89) and T1 (two years after the baseline) (Kappa > 0,91) using the dmft criteria. Parents/caregivers answered a socioeconomic questionnaire and the Brazilian version of the Early Childhood Oral Health Impact Scale (B-ECOHIS) at T0 and T1. Mann-Whitney test and hierarchically adjusted Poisson regression models were used (95%CI, p < 0,05). The incidence of untreated dental caries was 41.3%. Low (RR = 1.63; 95%CI:1.18–2.26; p < 0.001) and high severity of untreated dental caries (RR = 1.92; 95%CI:1.36–2.72; p < 0.001), monthly household income less than two times the Brazilian minimum salary (RR = 1.79; 95%CI:1.04–3.25; p = 0.042) and overall B-ECOHIS score (RR = 1.03; 95%CI:1.02–1.05; p < 0.001) at T0 were risk indicators for the incidence of untreated dental caries among the preschool children. In conclusion, the incidence of untreated dental caries was high and the higher severity of untreated dental caries, the lower monthly income and the higher the B-ECOHIS score (indicating a negative impact on quality of life) were risk indicators to the developing of new lesions of untreated dental caries after 2 years.

Keywords: Epidemiology; Oral Health; Quality of Life; Child, Preschool; Dental Caries.

Introduction

Early childhood caries (ECC) is one of the most common adverse health events among preschool children and is considered a public health problem associated with an impact on oral health-related quality of life (OHRQoL).[1-9] According to the Proceedings of the International Association of Paediatric Dentistry Bangkok Conference[1] on ECC, caries prevalence for 4-year-old children has ranged from 12.0% to 98.0%. Based on the latest national epidemiological survey conducted in Brazil,[10]

the prevalence of ECC among Brazilian preschool children is 53.4%.

Dietary and biological factors contribute to the development of dental caries in young children[11] and studies have demonstrated that its occurrence is more commonly detected among socially disadvantaged young children.[12,13] Greater prevalence rates of dental caries are associated with low parental schooling, low monthly household income,[11,13] larger number of siblings[14] and younger mothers.[15] Studies on the influence of behavioral, psychological, socioeconomic, dietary, and bacterial factors on the incidence of dental caries have found that children with this dental disease have a greater risk of developing new carious lesions in comparison to those who are caries-free.[16-20]

Epidemiological research developments have enhanced awareness of oral health inequalities. The life course approach is a concept that demonstrates how health inequalities result from the interaction of economic, behavioral, cultural, and psychosocial contexts over the years. Health status results from past and present living conditions and life experiences.[21,22] This approach provides explanations for the development of oral disease and for the perpetuation of health inequalities over the years.[23]

Despite the slowness to address social determinants of health through policy implementation, those are well known all over the world.[22] Dental policy tends to give restorative treatments and clinical interventions precedence over the management and prevention of the disease process, relying on simplistic downstream interventions and a fee-for-service model.[22,24]

Studies have demonstrated that moderate and extensive dental carious lesions are risk factors for deterioration of OHRQoL[25] and that they can negatively affect the lives of children, their families, and communities.[4,5,23] A cohort study based on a life course perspective indicated that early life factors play an important role in the development of ECC.[26] However, the majority of studies focus on the impact on oral health problems on quality of life, instead of assessing whether a poor OHRQoL may be an indicator of dental caries incidence. Considering the multifactorial etiology of dental caries, it is crucial to conduct prospective longitudinal studies investigating possible indicators of its incidence. The importance of such studies lies not only in the clarification of the causal relationships with the disease, but also in the establishment of effective public health policies. Moreover, knowledge of these factors can contribute to reducing the prevalence of dental caries and improving the quality of life of children and of their caregivers.

The aim of the present study was to evaluate the influence of socioeconomic factors, oral health status, and the impact of OHRQoL as possible risk for the incidence of untreated dental caries in preschool children 2 years after an initial examination. The hypothesis was that a low socioeconomic status as well as previous experience of severe dental caries and the impact on OHRQoL would be associated with the development of new carious lesions after 2 years.

Methodology

Subjects
A prospective longitudinal study was conducted with a sample of preschool children in Diamantina, state of Minas Gerais, Brazil. The sample size was calculated considering a 50.5% proportion of cases (new carious lesions during second examination) among exposed individuals (presence of caries at baseline) and 32.8% among unexposed individuals (absence of caries at baseline). These rates were obtained in a pilot study of 40 children. The sample size was also calculated based on a 5.0% level of significance and an 80.0% test power, which determined a minimum sample of 120 children per group (exposed and unexposed to dental caries). Finally, 24 individuals (20.0%) were added to each group to compensate for possible dropouts, resulting in the recruitment of 288 children and their parents/guardians.

Children were selected from a representative sample of 724 preschool children (aged 2 to 5 years) and their parents/caregivers who participated in a nested cross-sectional study[9] during immunization campaigns. Diamantina has a vaccine coverage rate greater than 90%[27]. Initially, all children aged 2 to 3 years (n=301) who participated in the nested cross-sectional study were allocated to two groups according to baseline information (T0): caries-free

children and those with untreated dental caries. A total of 144 children were then randomly selected from each of the groups based on the inclusion criteria and on the number of children required for this prospective study.

The inclusion criteria were: children aged 2–3 years at baseline (T0) and 3–5 years during the second examination (T1); accompanied by a Brazilian Portuguese-speaking parent/guardian living with the child for at least 12 hours a day. The following exclusion criteria were used: lack of cooperation during oral examination; ongoing orthodontic treatment; presence of systemic diseases, such as hormonal changes and disorders (reported by the caregiver); "don't know" answers for two or more items in the Child Impact Section or for one or more items in the Family Impact Section of the Brazilian version of the Early Childhood Oral Health Impact Scale (B-ECOHIS).[2,28]

Data collection: assessment of sociodemographic information and impact on children's OHRQoL

At baseline (T0), the parents/caregivers were asked to fill out a form containing three sections: a) sociodemographic data: marital status, mother's age, mother's and father's schooling, household income [categorized as more than or equal to twice the Brazilian monthly minimum wage (approximately US$ 500) or less than twice the minimum wage]; number of individuals living off the income and number of siblings; b) child's characteristics: age, sex, and health problems (such as asthma, influenza, colds, infections, etc.); and c) history of dental pain and perception of child's oral health.

Parents/caregivers also answered the B-ECOHIS[2,28] at baseline (T0), which was administered to assess the impact of oral health on the quality of life of the preschool children and their families.[29] This questionnaire has 13 items distributed into two sections: the child impact section and the family impact section. The child impact section has four domains: symptoms, function, psychology, and self-image/social interaction. The family impact section has two domains: parental distress and family function. Each item has six response options: 0 = never, 1 =

hardly ever, 2 = occasionally, 3 = often, 4 = very often, and 5 = don't know. The overall score of B-ECOHIS was determined by the total of the item scores. The total score ranges from 0 to 52, with higher scores denoting a greater impact on OHRQoL. "Don't know" responses were not counted.

Data collection: children's oral examination

The children were re-examined (T1) at the preschools by a single dentist who had undergone a training exercise. Inter-examiner and intra-examiner Kappa coefficients were greater than 0.8 for the oral health statuses evaluated (dmft, PUFA index, and oral hygiene). Oral examinations were performed in a room at the preschools reserved for this purpose and the examiner used personal protective equipment. As at baseline (T0), all children at T1 were examined while seated, under natural lighting, with the aid of disposable tongue depressors. Also, as at T0, a probe with a 0.5-mm ball tip was used, whenever necessary, to remove plaque and food debris that obstructed inspection and to confirm the presence of a cavitated carious lesion.

Untreated dental caries was diagnosed at T0 and T1 using the dmft index, as recommended by the World Health Organization.[30] Untreated dental caries was categorized as absent (cavitated lesions = 0), present (cavitated lesions > 1), caries-free (cavitated lesions = 0), mild caries (cavitated lesions = 1 to 5), or severe caries (cavitated lesions ≥ 6).[31] Children with treated caries at T1 were included in the caries-free group. Teeth with white spots were considered sound. Moreover, severe dental caries with visible pulpal involvement, ulceration caused by dislocated tooth fragments, fistula, or abscess was determined using the PUFA index[32] to assess the clinical consequences of untreated dental caries at T0 and T1 and categorized as absent (PUFA = 0) or present (PUFA ≥ 1). Oral hygiene was considered inadequate when dental plaque was clinically detectable.[12] At T1, the children were also categorized as "with new lesions of untreated caries" or "without new lesions of untreated caries". After the examination, all children with dental needs were sent for treatment at the Pediatric Dentistry Clinic of the Universidade Federal dos Vales do Jequitinhonha e Mucuri.

Data analysis

The data were organized and statistically analyzed using the Statistical Package for Social Sciences (SPSS for Windows, version 22.0, SPSS Inc, Chicago, IL, USA). Children were the unit of analysis for outcome assessment in this study. A conceptual proposal was structured to explain possible associations between the explanatory variables and new lesions of untreated dental caries (Figure 1).

Descriptive statistics were performed and the frequency distribution of the data was determined for the variables at T0 and T1. The socioeconomic independent variables were marital status, mother's age, mother's and father's schooling, monthly household income, number of individuals living off the income, and number of siblings. The independent variables related to the children's characteristics were age, sex, and health problems. The independent variables related to oral health status were severity of untreated dental caries, presence/absence of PUFA, history of dental pain, oral hygiene, parent's/caregiver's perception of the child's oral health, and overall mean B-ECOHIS score. The dependent variable for subsequent analyses was

only the presence of new untreated dental caries at T1. The Kolmogorov-Smirnov test was used to evaluate the normality of the data distribution of the quantitative variables (B-ECOHIS scores). As the distribution of the B-ECOHIS scores was non-normal ($p < 0.05$), the nonparametric Mann-Whitney test was used for comparisons between groups (with/without new lesions of untreated dental caries) for each item, section, and overall B-ECOHIS score.

A hierarchical approach was used for the selection of variables in the multivariate analyses.[33] Variables were grouped into a hierarchy of categories ranging from distal to proximal determinants. The categories were sociodemographic factors, child's characteristics, and oral health status (in that order). For each level, Poisson regression analysis with robust variance was performed to associate the independent variables evaluated at T0 with the absence/presence of new lesions of untreated dental caries evaluated at T1. This analysis was used to exclude variables with a p-value > 0.20. Explanatory variables with a p-value < 0.05 after adjustments for variables at the same or previous levels of determinants were selected for the
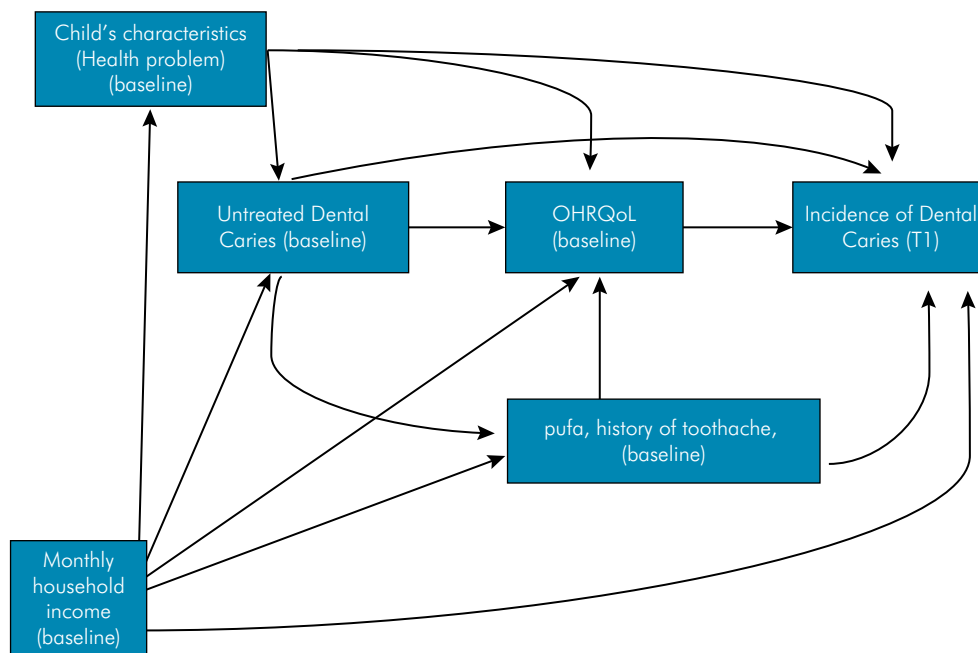

Figure 1. Flow chart describing the direction of the relation between the explanatory variables and new lesions of untreated dental caries.

final models. Relative risk (RR) and 95% confidence intervals (CI) were calculated.

Ethical considerations

This study was approved by the Human Research Ethics Committee of the Universidade Federal de Minas Gerais under protocol number 349.162. Parents/guardians received information about the objectives of the study and signed an informed consent form.

Results

The return rate for the two-year follow-up evaluation was 100%, totaling 288 preschool children and their parents/caregivers who participated in the present prospective longitudinal study. The incidence of children with untreated dental caries was 41.3% (n = 119) in the two-year follow-up. Considering the severity of untreated dental caries, the incidence of new carious lesions was 28.4% (n = 41) among children who were caries-free at baseline (T0), 48.4% (n = 47) among those with mild caries at T0, and 65.9% (n= 31) for those with severe caries at T0. Only 13% of the sample received restorative treatment for dental caries between T0 and T1. No children were excluded from the study for not cooperating during either of the clinical examinations. All parents/caregivers of the 288 children analyzed were interviewed and completed the sociodemographic and B-ECOHIS questionnaires at T0 and T1. Most of the questionnaires were answered by mothers (98.0%). At T1, 57.6% of the children (n = 166) were five years old and 147 (51.0%) were male. Household income of 86.8% of the families (n = 250) was less than twice the Brazilian monthly minimum wage during the second examination (T1), differing slightly from T0 (87.2%; n = 251).

Regarding the frequency distribution of the independent variables at baseline and second examination, no changes occurred in the marital status of the caregivers or number of individuals living off the household income at the end of the study. However, higher incidence rates were found during the second examination regarding the following variables: mother's (3.5%) and father's (1.0%) schooling greater than eight years, monthly household income equal to or greater than twice the minimum wage

(0.4%), two or more siblings (1.0%), and presence of health problems in children (1.4%). Table 1 displays the frequency distribution of oral health status at baseline and second examination. Mild (2.1%) and severe (10.1%) untreated dental caries, PUFA index (17.7%), history of dental pain (24.0%), inadequate oral hygiene (10.4%), parent's/caregiver's perception of child's oral health (16.0%), and overall B-ECOHIS score were associated with the incidence of untreated dental caries in the two-year follow-up period.

Table 2 displays the frequency distribution of dental caries in the preschool children according to the independent variables at T0 and T1. The majority

Table 1. Frequency distribution of preschool children (n = 288) according to oral health status at baseline (T0) and second examination (T1).

Variable	T0	T1
	n (%)	n (%)
Oral health status		
Severity of untreated dental caries		
Caries-free (cavitated lesions = 0)	144 (50.0)	109 (37.8)
Mild (cavitated lesions = 1–5)	97 (33.7)	103 (35.8)
Severe (cavitated lesions ≥ 6)	47 (16.3)	76 (26.4)
pufa		
Absent	271 (94.1)	220 (76.4)
Present	17 (5.9)	68 (23.6)
History of dental pain		
No	230 (79.9)	161 (55.9)
Yes	58 (20.1)	127 (44.1)
Oral hygiene		
Satisfactory	184 (63.9)	154 (53.5)
Unsatisfactory	104 (36.1)	134 (46.5)
Parent's/caregiver's perception of child's oral health		
Good	265 (92.0)	219 (76.0)
Poor	23 (8.0)	69 (24.0)
Impact on quality of life (B-ECOHIS)		
Total score	2.28 (± 5.038)[*]	7.47 (±5.038)[*]

pufa: severely decayed teeth with visible pulpal involvement, ulceration caused by dislocated tooth fragments, fistula, or abscess; B-ECOHIS: Brazilian version of Early Childhood Oral Health Impact Scale; [*]Data expressed as mean (standard deviation).

Table 2. Frequency distribution of untreated dental caries in preschool children (n = 288) according to independent variables at baseline (T0) and second examination (T1).

Independent variables	Untreated dental caries	
	T0	T1
	n (%)	n (%)
Marital status		
Parents living together	94 (65.3)	121 (67.6)
Parents separated	50 (34.7)	58 (32.4)
Mother's age		
18–24 years	58 (40.2)	69 (38.5)
25–30 years	43 (29.9)	54 (30.2)
31–48 years	43 (29.9)	56 (31.3)
Mother's schooling		
≥ 8 years	69 (47.9)	89 (49.7)
< 8 years	75 (52.1)	90 (50.3)
Father's schooling		
≥ 8 years	52 (36.1)	73 (40.8)
< 8 years	92 (63.9)	106 (59.2)
Monthly household income		
≥ twice the minimum wage	13 (9.0)	16 (8.9)
< twice the minimum wage	131 (91.0)	163 (91.1)
Number of individuals living off the income		
1–3	36 (25)	51 (28.5)
4– 5	69 (47.9)	79 (44.1)
6 or more	39 (27.1)	49 (27.4)
Number of siblings		
None	36 (25)	44 (24.6)
One	58 (40.3)	69 (38.5)
Two or more	50 (34.7)	66 (36.9)
Health problem		
No	123 (85.4)	155 (86.6)
Yes	21 (14.6)	24 (13.4)
pufa		
Absent	127 (88.2)	113 (63.1)
Present	17 (11.8)	66 (36.9)
History of dental pain		
No	98 (68.1)	64 (35.8)
Yes	46 (31.9)	115 (64.2)
Oral hygiene		
Satisfactory	44 (30.6)	48 (26.8)
Unsatisfactory	100 (69.4)	131 (73.2)
Parent's/caregiver's perception of child's oral health		
Good	121 (84.0)	110 (61.5)
Poor	23 (16.0)	69 (38.5)
Impact on quality of life (B-ECOHIS)		
Total score – mean (SD)	3.49 (6.21)*	10.83 (9.88)*

pufa: severely decayed teeth with visible pulpal involvement, ulceration caused by dislocated tooth fragments, fistula, or abscess; B-ECOHIS: Brazilian version of Early Childhood Oral Health Impact Scale; *Data expressed as mean (standard deviation).

of parents/caregivers reported no impact on OHRQoL (66.0%) (ECOHIS score = 0) at T0. Parents reported more impacts related to the child (29.2%) than to the family (18.4%). The highest overall B-ECOHIS score was 33. Maximum scores in the child impact section and family impact section were 31 and 11, respectively. Table 3 displays the distribution of the means for each B-ECOHIS item in each domain and the overall B-ECOHIS score at T0 according to the absence/presence of new lesions of untreated dental caries at T1.

Univariate analysis and the final analyses with the hierarchical model are described in Table 4. The final multivariate hierarchical model comprised three covariates. Monthly household income less than twice the minimum wage (RR = 1.79; 95% CI: 1.04–3.25; p = 0.042), mild (RR = 1.63, 95% CI: 1.18–2.26, p < 0.001) and severe untreated dental caries (RR = 1.92; 95% CI: 1.36–2.72; p < 0.001), and overall B-ECOHIS score (RR = 1.03; 95% CI: 1.02–1.05; p < 0.001) at baseline were risk indicators of the incidence of untreated dental caries among preschool children during the second examination.

Discussion

In the present study, severe untreated dental caries, low monthly income, and high B-ECOHIS score (indicating a negative impact on quality of life) at baseline were risk indicators of the incidence of carious lesions after the two-year follow-up. Previous studies have found that health status results from past and present living conditions and life experiences.[21-23] This approach provides explanations for the development of oral disease, as well as for the perpetuation of health inequalities over the years (regardless of improvements in living conditions and health knowledge and promotion across generations).[22,23] The majority of studies on ECC and OHRQoL have a cross-sectional design and focus on the impact of oral health problems on quality of life, instead of assessing whether a poor OHRQOL may be an indicator of dental caries incidence.[2-9] When considering the multifactorial etiology of dental caries, it is crucial to take into account longitudinal pathways with theoretical models related to the life

Table 3. Distribution and comparison of mean scores for each item and overall B-ECOHIS at baseline (T0) according to absence/presence of new lesions of untreated dental caries among children in the second examination (T1).

B-ECOHIS (T0)	New lesions of untreated dental caries (T1)		
	Absent	Present	p-value*
Child impact section	0.76 (2.05)	2.99 (5.42)	< 0.001
Symptom domain (SD)			
Oral/dental pain	0.28 (0.71)	0.82 (1.13)	< 0.001
Function domain (FD)			
Difficulty drinking	0.09 (0.44)	0.40 (0.10)	0.001
Difficulty eating	0.04 (0.27)	0.47 (1.10)	< 0.001
Difficulty pronouncing words	0.05 (0.30)	0.18 (0.66)	0.035
Missed preschool or school	0.01 (0.07)	0.13 (0.61)	0.015
Psychological domain (PD)			
Trouble sleeping	0.08 (0.38)	0.28 (0.82)	0.007
Irritable or frustrated	0.14 (0.56)	0.53 (1.02)	< 0.001
Self-image/social interaction domain (SSD)			
Avoided smiling or laughing	0.04 (0.28)	0.16 (0.70)	0.059
Avoided talking	0.04 (0.34)	0.12 (0.64)	0.103
Family impact section	0.34 (1.18)	1.00 (1.90)	< 0.001
Parental distress domain (PDD)			
Been upset	0.10 (0.43)	0.41 (0.93)	< 0.001
Felt guilt	0.18 (0.61)	0.35 (0.80)	0.027
Family function domain (FFD)			
Taken time off from work	0.05 (0.31)	0.13 (0.52)	0.069
Financial impact	0.02 (0.17)	0.09 (0.45)	0.099
Overall B-ECOHIS	1.10 (2.97)	3.97 (6.65)	< 0.001

Values expressed as mean (standard deviation); B-ECOHIS: Brazilian version of Early Childhood Oral Health Impact Scale; *Mann-Whitney test (p < 0.05).

course theory and to investigate other indicators, such as OHRQoL.

In this study, which was conducted with a two-year follow-up period, the incidence of untreated dental caries among preschool children was 41.3%, which is higher than the rate reported in a longitudinal study involving children living in the southern suburbs of Stockholm,[17] aged between 24 and 36 months at baseline, whereas 11.3% exhibited dental caries, but its prevalence in the follow-up examination one year later was 36.7%. According to the authors, the high incidence rate of dental caries may partially be so because, besides having a diet with a high sugar content and unsatisfactory oral hygiene, affected children were more frequently colonized by *Mutans*, *Streptococci*, and Lactobacilli.[17]

A household income less than twice the Brazilian monthly minimum wage was also an indicator of the development of new lesions of dental caries two years after the baseline examination. Several studies have suggested that socioeconomic factors, such as low monthly household income, exert an influence on the prevalence of ECC among preschool children.[10-13] Conversely, a study involving Chinese children found a greater incidence of dental caries among families with a higher monthly income.[26] Lower household income has been consistently associated with limited access to information on health and limited access to healthcare services, which characterizes dental caries as a polarized oral problem.[12,13] Polarization means that a particular proportion of the population is more affected, especially less privileged individuals with

Table 4. Univariate regression and final analyses with hierarchical model for associations among independent variables evaluated at baseline (T0) and presence of new lesions of untreated dental caries in preschool children in the second examination (T1).

Independent variables – T0	unadjusted RR (95% CI)	p-value*	unadjusted RR (95% CI)	p-value*
Level 1 - Sociodemographic factors				
Marital status				
Parents living together	1			
Parents separated	0.83 (0.62–1.13)	0.246	–	-
Mother's age				
18 to 24 years	1			
25 to 30 years	1.15 (0.83–1.60)	0.401	–	-
31 to 48 years	1.02 (0.73–1.44)	0.892	–	-
Mother's schooling				
≥ 8 years	1			
< 8 years	1.12 (0.85–1.47)	0.416	–	-
Father's schooling				
≥ 8 years	1			
< 8 years	1.01 (0.76–1.34)	0.921	–	-
Monthly household income				
≥ twice the minimum wage	1		1	
< twice the minimum wage	2.04 (1.09–3.83)	0.026	1.79 (1.04–3.25)	0.042
Number of individuals living off the income				
1 to 3	1			
4 to 5	1.06 (0.76–1.47)	0.738	–	-
6 or more	1.03 (0.70–1.50)	0.889	–	-
Number of siblings				
None	1			
One	0.99 (0.69–1.43)	0.976	–	-
Two or more	1.20 (0.85–1.69)	0.306	–	-
Level 2 - Child's characteristics				
Age				
24-35 months	1			
36-47 months	1.30 (0.97–1.74)	0.079	–	-
Sex				
Male	1			
Female	1.02 (0.78–1.35)	0.859	–	-
Health problem				
No	1			
Yes	0.82 (0.53–1.24)	0.348	–	-
Level 3 - Oral health status				
Severity of untreated dental caries				
Caries-free (cavitated lesions = 0)	1		1	
Mild (cavitated lesions = 1 to 5)	1.70 (1.22–2.37)	0.002	1.63 (1.18–2.26)	< 0.001
Severe (cavitated lesions ≥ 6)	2.32 (1.66–3.22)	0.001	1.92 (1.36–2.72)	< 0.001

Continuation

pufa				
Absent	1			
Present	1.95 (1.44–2.64)	< 0.001	–	-
History of dental pain				
No	1			
Yes	1.79 (1.38–2.32)	< 0.001	–	-
Oral hygiene				
Satisfactory	1			
Unsatisfactory	2.20 (1.68–2.88)	< 0.001	–	-
Parent's/caregiver's perception of child's oral health				
Good	1			
Poor	1.66 (1.19–2.32)	0.003	–	-
Impact on quality of life (B-ECOHIS)				
Total score	1.05 (1.03–1.06)	< 0.001	1.03 (1.02–1.05)	< 0.001

RR: Relative risk; CI: Confidence interval; pufa: severely decayed teeth with visible pulpal involvement, ulceration caused by dislocated tooth fragments, fistula, or abscess; B-ECOHIS: Brazilian version of Early Childhood Oral Health Impact Scale; †data expressed as mean and standard deviation; * Unadjusted Poisson regression.

greater treatment needs.[11] In developing countries, such as Brazil, dental caries continues to be a huge public health problem.

In the present study, mild and severe untreated dental caries at baseline were indicators of the incidence of dental caries in the two-year follow-up examination. In a previous longitudinal study involving African American preschool children with a four-year follow-up period, the development of new cavitated carious lesions was also associated with the presence of baseline caries.[20] Similar findings have been reported in another previous longitudinal study with a one-year follow-up period, in which children with caries experience at baseline also had a much higher risk of developing new lesions than did caries-free children.[17] Another longitudinal study has demonstrated that preschool children with ECC are at higher risk for developing future carious lesions than preschool children who are caries-free.[18] Thus, there is a real need for intervention in the natural course of this oral health problem with the treatment of carious lesions in the primary dentition. Although we recognize the importance of treating carious lesions to control the increase of this oral disease in the future, we found in our study that even after referring all children with dental caries for treatment

and reporting the data found in baseline examination to public health agencies, only 13.0% of the sample sought dental care during the two-year follow-up period. Consequently, it should be emphasized that it is necessary to act more assertively in raising awareness of parents/guardians and public health agencies of the importance of prevention and treatment of carious lesions as early as possible.

The present findings confirm the hypothesis that OHRQoL also adversely affects the incidence of untreated dental caries in preschool children. Dental pain, irritability, difficulty in eating and drinking, and trouble sleeping were also the most common difficulties reported by parents in previous investigations regarding the impact of dental caries on children and their families.[1-8] Those studies, however, were performed with a cross-sectional design and suggest that dental caries is a possible cause of pain, chewing difficulties, speech impairment, sleeping difficulties, changes in behavior, and absenteeism among preschool children. The present investigation is the first prospective longitudinal study addressing the negative impact on quality of life as an indicator of the incidence of untreated dental caries in preschool children, irrespectively of the presence of baseline caries.

Knowledge of the negative impact on quality of life as an aggravating factor for new dental carious lesions may contribute to the adoption of public health policies and encourage the development of preventive strategies. An evaluation about parental perspectives of children with ECC may contribute to the development and improvement of caries prevention strategies. A previous study[34] has found that parents had limited knowledge of possible practices that contribute to the prevention of ECC and of when to seek regular dental care. Moreover, parents expected pediatricians to provide education on how to prevent childhood caries and conduct preliminary oral health assessments. Therefore, pediatricians and pediatric dentists should take responsibility for engaging and educating parents on fostering optimal oral health and helping early prevention and management of ECC. Additionally, more longitudinal studies should be conducted with young children to evaluate the influence of OHRQoL and other indicators of the incidence of ECC.

In the present study, dental caries was diagnosed using the dmft index recommended by the World Health Organization,[30] which is often employed in epidemiological studies. Nonetheless, this index only considers cavitated lesions. Current indices also consider the initial stages of dental caries and its activity, such as the modified International Caries Detection and Assessment System (ICDAS II).[35] Therefore, it is important for future studies to employ indices that allow a more accurate diagnosis of dental caries by also considering active white spots, thereby enhancing the sensitivity of the diagnosis of dental caries. Given that in the present study non-cavitated caries lesions were not considered during dental examination, the prevalence of dental caries may have been underestimated in both examinations and it is possible that part of the children who developed dental caries during the follow-up period had active white spots at baseline that were not documented. Thus, non-cavitated lesions should be considered in future studies, because such lesions can be controlled using non-invasive approaches, reducing treatment costs.[35] On the other hand, a previous study has shown that dental caries in early or established stages does not have an impact on the quality of life of preschool children, unlike severe dental caries.[8]

Oral health problems (*e.g.*, mild and severe untreated dental caries), socioeconomic aspects (*e.g.*, household income less than twice the Brazilian monthly minimum wage), and the negative impact of OHRQoL were indicators of a greater incidence of untreated dental caries after a two-year follow-up period. As dental caries remains a prevalent health problem among preschool children, it is crucial to identify children exposed to these factors as early as possible and provide interventions to control and reduce the incidence of this disease.

Conclusion

The higher severity of untreated dental caries, the lower monthly income, and the higher B-ECOHIS score (indicating a negative impact on quality of life) were risk indicators of the development of new lesions of untreated dental caries after 2 years.

Acknowledgments

References

1. Tinanoff N, Baez RJ, Diaz Guillory C, Donly KJ, Feldens CA, McGrath C, et al. Early childhood caries epidemiology, aetiology, risk assessment, societal burden, management, education, and policy: global perspective. Int J Paediatr Dent. 2019 May;29(3):238-48. https://doi.org/10.1111/ipd.12484

2. Abanto J, Carvalho TS, Mendes FM, Wanderley MT, Bönecker M, Raggio DP. Impact of oral diseases and disorders on oral health-related quality of life of preschool children. Community Dent Oral Epidemiol. 2011 Apr;39(2):105-14. https://doi.org/10.1111/j.1600-0528.2010.00580.x

3. Scarpelli AC, Oliveira BH, Tesch FC, Leão AT, Pordeus IA, Paiva SM. Psychometric properties of the Brazilian version of the Early Childhood Oral Health Impact Scale (B-ECOHIS). BMC Oral Health. 2011 Jun;11(1):19. https://doi.org/10.1186/1472-6831-11-19

4. Martins MT, Sardenberg F, Vale MP, Paiva SM, Pordeus IA. Dental caries and social factors: impact on quality of life in Brazilian children. Braz Oral Res. 2015;29(1):S1806-83242015000100310. https://doi.org/10.1590/1807-3107BOR-2015.vol29.0133

5. Martins-Júnior PA, Vieira-Andrade RG, Corrêa-Faria P, Oliveira-Ferreira F, Marques LS, Ramos-Jorge ML. Impact of early childhood caries on the oral health-related quality of life of preschool children and their parents. Caries Res. 2013;47(3):211-8. https://doi.org/10.1159/000345534

6. Ramos-Jorge J, Pordeus IA, Ramos-Jorge ML, Marques LS, Paiva SM. Impact of untreated dental caries on quality of life of preschool children: different stages and activity. Community Dent Oral Epidemiol. 2014 Aug;42(4):311-22. https://doi.org/10.1111/cdoe.12086

7. Li MY, Zhi QH, Zhou Y, Qiu RM, Lin HC. Impact of early childhood caries on oral health-related quality of life of preschool children. Eur J Paediatr Dent. 2015 Mar;16(1):65-72.

8. Ramos-Jorge J, Alencar BM, Pordeus IA, Soares ME, Marques LS, Ramos-Jorge ML, et al. Impact of dental caries on quality of life among preschool children: emphasis on the type of tooth and stages of progression. Eur J Oral Sci. 2015 Apr;123(2):88-95. https://doi.org/10.1111/eos.12166

9. Vieira-Andrade RG, Martins-Júnior PA, Corrêa-Faria P, Marques LS, Paiva SM, Ramos-Jorge ML. Impact of oral mucosal conditions on oral health-related quality of life in preschool children: a hierarchical approach. Int J Paediatr Dent. 2015 Mar;25(2):117-26. https://doi.org/10.1111/ipd.12107

10. Ministério da Saúde (BR). Pesquisa nacional de saúde bucal: SB Brasil 2010: resultados principais. Brasília, DF: Ministério da Saúde; 2011.

11. Harris R, Nicoll AD, Adair PM, Pine CM. Risk factors for dental caries in young children: a systematic review of the literature. Community Dent Health. 2004 Mar;21(1 Suppl):71-85.

12. Oliveira LB, Sheiham A, Bönecker M. Exploring the association of dental caries with social factors and nutritional status in Brazilian preschool children. Eur J Oral Sci. 2008 Feb;116(1):37-43. https://doi.org/10.1111/j.1600-0722.2007.00507.x

13. Corrêa-Faria P, Martins-Júnior PA, Vieira-Andrade RG, Marques LS, Ramos-Jorge ML. Factors associated with the development of early childhood caries among Brazilian preschoolers. Braz Oral Res. 2013 Jul-Aug;27(4):356-62. https://doi.org/10.1590/S1806-83242013005000021

14. Wellappuli N, Amarasena N. Influence of family structure on dental caries experience of preschool children in Sri Lanka. Caries Res. 2012;46(3):208-12. http://doi.org/ https://doi.org/10.1159/000337399

15. Niji R, Arita K, Abe Y, Lucas ME, Nishino M, Mitome M. Maternal age at birth and other risk factors in early childhood caries. Pediatr Dent. 2010 Nov-Dec;32(7):493-8.

16. Parisotto TM, Steiner-Oliveira C, De Souza-E-Silva CM, Peres RC, Rodrigues LK, Nobre-Dos-Santos M. Assessment of cavitated and active non-cavitated caries lesions in 3- to 4-year-old preschool children: a field study. Int J Paediatr Dent. 2012 Mar;22(2):92-9. https://doi.org/10.1111/j.1365-263X.2011.01171.x

17. Grindefjord M, Dahllöf G, Modéer T. Caries development in children from 2.5 to 3.5 years of age: a longitudinal study. Caries Res. 1995;29(6):449-54. http://doi.org/doi https://doi.org/10.1159/000262113

18. Peretz B, Ram D, Azo E, Efrat Y. Preschool caries as an indicator of future caries: a longitudinal study. Pediatr Dent. 2003 Mar-Apr;25(2):114-8.

19. Parisotto TM, Santos MN, Rodrigues LK, Costa LS. Behavior and progression of early carious lesions in early childhood: a 1-year follow-up study. J Dent Child (Chic). 2012 Sep-Dec;79(3):130-5.

20. Lim S, Tellez M, Ismail AI. Dental caries development among African American children: results from a 4-year longitudinal study. Community Dent Oral Epidemiol. 2015 Jun;43(3):200-7. Available from: http://doi.org/doi:10.1111/cdoe.12140

21. Sisson KL. Theoretical explanations for social inequalities in oral health. Community Dent Oral Epidemiol. 2007 Apr;35(2):81-8. https://doi.org/10.1111/j.1600-0528.2007.00354.x

22. Peres MA, Macpherson LM, Weyant RJ, Daly B, Venturelli R, Mathur MR, et al. Oral diseases: a global public health challenge. The Lancet. 2019 Mar;394(10194):249-260. https://doi.org/10.1016/S0140-6736(19)31146-8

23. Torppa-Saarinen E, Suominen AL, Lahti S, Tolvanen M. Longitudinal pathways between perceived oral health and regular service use of adult Finns. Community Dent Oral Epidemiol. 2019 June;47(5):374-380. https://doi.org/10.1111/cdoe.12478

24. Tinanoff N, Baez RJ, Diaz Guillory C, Donly KJ, Feldens CA, McGrath C, et al. Early childhood caries epidemiology, aetiology, risk assessment, societal burden, management, education, and policy: global perspective. Int J Pediatr Dent. 2019 May; 29(3):238-248. https://doi.org/10.1111/ipd.12484

25. Guedes RS, Ardenghi TM, Piovesan C, Emmanuelli B, Mendes FM. Influence of initial caries lesions on quality of life in preschool children: a 2-year cohort study. Community Dent Oral Epidemiol. 2016 Jun;44(3):292-300. https://doi.org/10.1111/cdoe.12217

26. Zhou Y, Yang JY, Lo EC, Lin HC. The contribution of life course determinants to early childhood caries: a 2-year cohort study. Caries Res. 2012;46(2):87-94. https://doi.org/10.1159/000335574

27. Instituto Brasileiro de Geografia e Estatística. Estimativas populacionais para os municípios brasileiros. Rio de Janeiro: Instituto Brasileiro de Geografia e Estatística; 2010 [cited 2021 Feb 21]. Available from: http://www.ibge.gov.br/home/presidencia/noticias/pesquisa_noticia.php

28. Martins-Júnior PA, Ramos-Jorge J, Paiva SM, Marques LS, Ramos-Jorge ML. Validations of the Brazilian version of the Early Childhood Oral Health Impact Scale (ECOHIS). Cad Saude Publica. 2012 Feb;28(2):367-74. https://doi.org/10.1590/S0102-311X2012000200015

29. Pahel BT, Rozier RG, Slade GD. Parental perceptions of children's oral health: the Early Childhood Oral Health Impact Scale (ECOHIS). Health Qual Life Outcomes. 2007 Jan;5:6. https://doi.org/10.1186/1477-7525-5-6

30. World Health Organization. Oral health surveys: basic methods. 4th. Geneva: Word Health Organization; 1997.

31. Hallett KB, O'Rourke PK. Caries experience in preschool children referred for specialist dental care in hospital. Aust Dent J. 2006 Jun;51(2):124-9. https://doi.org/10.1111/j.1834-7819.2006.tb00415.x

32. Monse B, Heinrich-Weltzien R, Benzian H, Holmgren C, Palenstein Helderman W. PUFA: an index of clinical consequences of untreated dental caries. Community Dent Oral Epidemiol. 2010 Feb;38(1):77-82. https://doi.org/10.1111/j.1600-0528.2009.00514.x

33. Victora CG, Huttly SR, Fuchs SC, Olinto MT. The role of conceptual frameworks in epidemiological analysis: a hierarchical approach. Int J Epidemiol. 1997 Feb;26(1):224-7. https://doi.org/10.1093/ije/26.1.224

34. Inyang A. Isong, Donna Luff, James M Perrin, Jonathan P Winickoff, Man Wai Ng. Parental perspectives of early childhood caries. Clin Pediatr (Phila). 2012;51(1):77-85. http://doi.org/doi:10.1177/0009922811417856

35. Shoaib L, Deery C, Ricketts DN, Nugent ZJ. Validity and reproducibility of ICDAS II in primary teeth. Caries Res. 2009;43(6):442-8. https://doi.org/10.1159/000258551