Original Research
Cariology

Is there an association between family structure and the oral health of socially vulnerable children?

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Abstract: The aim of this study was to evaluate the impact of the family structure on the oral health status of socially vulnerable children in the Federal District of Brazil. A total of 471 schoolchildren with a mean age of 8.12 (± 0.90) years were examined for dental caries using the CAST instrument. Dental biofilm and oral pain were also registered. Children's guardians were interviewed about socioeconomic variables and oral hygiene habits. The association between oral pain in the previous 30 days and the child's maximum CAST score were analyzed using the Pearson chi-squared test. Multivariate Poisson regression models with robust variance were used to determine the predictors of presence of biofilm, oral pain, and caries severity. The prevalence of cavitated dentin lesions was 43.74% and, both dentin and enamel lesions, 52.87%; for both dentitions. An association between pain and severe nontreated carious lesions was found ($p < 0.0001$). The family structure was not related to the presence of dental caries, but a significant association was found between low maternal education and severe carious lesions (PR = 1.41; $p = 0.0077$) and oral pain (PR = 1.47; $p = 0.0335$); not owning a residence and frequency of toothbrushing were also associated with the substantial presence of biofilm (PR = 1.13, $p = 0.0493$ and PR = 1.18, $p = 0.0470$; respectively). For socially vulnerable children, variables related to the socioeconomic status of the families were more relevant than the family structure in relation to their oral health status.

Keywords: Dental Caries; Marital Status; Prevalence; Child.

Introduction

Although dental caries has been mitigated by many preventive measures, this disease continues to be a significant threat to oral health, negatively affecting the individual's quality of life.[1-3] Nearly half of the world population suffers disability as a consequence of oral health conditions, which remain highly prevalent to this day.[4] According to the Global Burden of Disease 2010, cavitated lesions in permanent teeth were the most prevalent condition among 291 diseases affecting 2.5 billion people worldwide.[5] Moreover, oral disorders, were among the 25 of 369 diseases that most affect young adults (25–49 years old).[6] Thus, in addition to providing appropriate treatment for these carious lesions,

determining the caries risk of individuals is extremely important in the management of dental caries, with the purpose of avoiding the occurrence of these risks and preventing the disease.[7,8]

Dental caries is a social disease, and its development is associated with biological, dietary, behavioral, and socioeconomic factors, as well as to having access to consumer goods and health services.[9,10] The correlation between children's oral health and social factors such as family income, parents' education, and other variables has been studied.[11,12] National surveys conducted in Brazil have shown that socially deprived populations were at particular risk of severe oral health disease.[13,14] Furthermore, the parents' psychological status, behavior, and attitudes has been reported to affect their children's general and oral health status.[2] The family and the mother's behaviors affect the child's quality of life, general and oral health, and play a key role in determining the oral health status of children.[2,15,16]

The association between the development of dental caries in children and the level of maternal education has been identified.[17,18] The marital status of parents has also been reported to affect the development of dental caries in children,[15,19] with the highest odds of children with mother "Never Married" presenting more carious lesions than mother "Married/Living partner" or "Widowed/Divorced".[19] Furthermore, there has been some indication that children in single-parent households were at the highest risk of developing dental caries.[15,17,19] However, there is lack of a consensus on this topic since as there have been reports in which no association between family structure and oral health problems were observed, showing that the child's experience of caries depended less on marital status than on maternal need for dental treatment, family income, and/or maternal level of education.[11,20,21] These contradictory data indicate that further research is needed to establish reliable evidence, so that public policies that specifically target communities in situations of social vulnerability can be implemented to prevent and/or control dental caries. The aim of the present study was to evaluate the impact of the family structure on the child's oral health status in a population considered a highly vulnerable social group.

Methodology

Ethical clearance

The study was approved by the Research Ethics Committee of the of the Health Sciences Teaching and Research Foundation (CAAE 00617218.3.0000.5553) of the Health Education, Federal District, and authorized by the local Education and Health Department. It was conducted in full accordance with the World Medical Association Declaration of Helsinki.

Parents/children were informed about the aims of the study and signed the terms of informed consent and assent, as appropriate. Children in need of dental treatment were either treated on the school premises or referred to the local Public Oral Health Center.

Study design and sample population

This was a cross-sectional study in which a minimum sample size of 267 children was calculated to report descriptive outcomes of interest with a 95% confidence interval (95%CI) and a 6% error margin (standard error = 3%). A correction factor of 2 was applied to allow for non-respondents (n = 534).

Cidade Estrutural and Sol Nascente, places in which the study was carried out were chosen as they represented the poorest urban living areas in the capital of Brazil. The per capita monthly income of individuals in Cidade Estrutural was U$ 124.00 and in Sol Nascente, U$ 163.00, contrasting dramatically with the average of U$ 580.36 observed in the Federal District, the highest per capita income among Brazilians[22,23]. All schoolchildren enrolled in primary education (6 to 9 years old) from the two schools selected were invited to participate (n = 912). Children were excluded in case parents did not sign the term of informed consent or due to missing values on covariates, totalizing a final sample of 471 participants.

Training and calibration

A single pediatric dentist performed all examinations. The examiner training consisted of a 4-hour theoretical lecture provided by an expert in using CAST, in which tooth images were exhibited, including those of teeth with other alterations. For the calibration exercise, schoolchildren of the same

age as those who would participate in the main study were examined until an adequate level of intra-examiner agreement was reached. During the main study, the intra-examiner agreement coefficient was calculated on the basis of 10% of the population studied. The intra-examiner agreement coefficient (weighted kappa) for caries detection in permanent teeth was 1.00, and in deciduous teeth was 0.84.

The socioeconomic and health questionnaires were applied at the school premises by 7 trained dentists who were also calibrated in 4 meetings, to prevent the parent's response from being influenced.

Data collection

Clinical examinations were performed on the school premises in a room made available for the study, using a portable bed, a help desk and an artificial light. All participating children, after being placed on the portable bed, were submitted to the following examinations: assessment of overall oral pain history and oral pain history in the previous 30 days; assessment of the presence of dental biofilm and carious lesions per tooth.

Initially, the examiner asked the child about the presence of oral pain in the last 30 days (yes or no; if yes, location in the mouth) and about previous experience of oral pain (yes or no). The examination performed by visual inspection began by recording the presence of biofilm per tooth (clean tooth, hardly visible or substantial amount). Then, the examiner removed the biofilm with a toothbrush without toothpaste and dried the teeth with gauze. Immediately afterward, using a dental mirror and a CPI probe, dental caries was recorded according to the CAST (Caries Assessment Spectrum and Treatment) instrument, which encompasses the full spectrum of dental caries, detects the severity of the disease, the population's treatment needs and the presence of dental treatments[24,25,26] (Table 1).

Interviews with the parents/guardians were held in an open area to avoid embarrassment among the participants. They were asked questions about their child's general and oral health, the child's dietary and dental hygiene habits, and how often the child performed tooth brushing. The interviewers recorded the data directly into a Google form link.

Data analysis

Dental caries prevalence was calculated according to the CAST instrument and to the WHO criteria. To do so, the participant's maximum CAST score (considering both dentitions) was used following the CAST guidelines. This meant that CAST codes 2 and 8 were not included. In addition, children were grouped into mild/moderate vs severely affected

Table 1. The codes and descriptions of the hierarchical Caries Assessment Spectrum and Treatment (CAST) instrument.

Characteristics	Code	Description
Sound	0	No visible evidence of a distinct carious lesion is present
Sealant	1	Pits and/or fissures are at least partially covered with a sealant material
Restoration	2	A cavity is restored with an (in)direct restorative material
Enamel	3	Distinct visual change in enamel only. A clear caries-related discoloration is visible, with or without localized enamel breakdown
Dentin	4	Internal caries-related discoloration in dentin. The discolored dentin is visible through enamel, which may or may not exhibit a visible localized breakdown of enamel
	5	Distinct cavitation into dentin. The pulp chamber is intact
Pulp	6	Involvement of the pulp chamber. Distinct cavitation reaching the pulp chamber or only root fragments present
Abscess/fistula	7	A pus-containing swelling or a pus-releasing sinus tract related to a tooth with pulpal involvement
Lost	8	The tooth has been removed because of dental caries
Other	9	Does not correspond to any of the other descriptions

individuals, taking into account the participant's CAST severity score (F1 = 0.25* CAST3 + 1* CAST4 + 2* CAST5 + 4* CAST6 + 5* CAST7 + 6* CAST8)[25], in which the number * indicated the weight given to the respective CAST codes. A CAST severity score > 6 was established as a threshold to differentiate mild/moderate from severe disease. For the WHO criteria, CAST codes were converted into DMF/dmf components.[26] Mean DMFT values were calculated, and the respective 95% confidence intervals were constructed.

The association between the occurrence of oral pain in the last 30 days and the maximum CAST score was analyzed using the Pearson chi-squared test. A standardized residual analysis was used to determine the direction of the association between the variables. Standardized residuals greater than 2, in a module, indicated statistical significance.

Multivariate Poisson regression models with robust variance were used to determine whether the predictors—daily toothbrushing frequency, family structure, household head, maternal education level, total income, income per capita, type of house, home ownership—were significant factors for the occurrence of dental plaque (substantial vs hardly visible/clean tooth), CAST severity score (> 6 vs ≤ 6), oral pain in the last 30 days (yes vs no) and past oral pain history (yes vs no).

A bivariate and multiple analysis was performed. The prevalence ratios and the confidence intervals of 95% for both analyses were calculated. Initially, simple Poisson regression models were adjusted for each predictor. If $p < 0.252$, the predictor was included in the multiple Poisson regression analysis. Subsequently, adjustments were made to these predictors by removing/including variables. Only those with $p < 0.05$ remained in the final model.

$P < 0.05$ was considered significant. The analyses were performed using the SAS 9.4 program.

Results

In total, 471 oral examinations were performed and interviews held. The sample consisted of 252 boys and 219 girls, with a mean age of 8.12 years (± 0.90). The distribution of the children by school was 219 from Cidade Estrutural and 252 from Sol Nascente. No socioeconomic/demographic differences were observed between schoolchildren from the two schools. The overall sample characteristics are presented in Table 2.

Caries prevalence

Table 3 displays the percentage of children according to their maximum CAST codes and disease status. The caries prevalence in both types of dentition was 43.74% and 52.87% considering cavitated dentin lesions (CAST 5-7) and enamel + dentin lesions (CAST 3-7), respectively. Only 4.46% of the sample were observed to have received a sealant (CAST 1) or a restoration (CAST 2), which could be considerate low, taking into account the 11.89% who had already lost a tooth due to caries. Therefore, tooth extraction (CAST 8) was provided nearly 3 times more frequently than preventive/restorative care.

When data was reported according to gender among individuals with caries, overall caries prevalence (CAST 3-7) was 51.81% for boys and 48.19% for girls. When differentiating between primary and permanent dentition the following values were found: 48% (girls, primary dentition); 52% (boys, primary dentition) and 41.82 (girls, permanent dentition) and 58.18% (boys, permanent dentition).

By converting CAST codes into dmf components, the following was found: a mean dmft of 2.12 (± 0.59) and a mean DMFT of 0.20 (± 2.55). On analyzing the dentitions separately, carious lesions already at the dentin level were observed in approximately 11% of the permanent teeth.

Cast severity score

The mean standard deviation of the severity score was 5.85 (±8.03) and the median (interquartile range) was 2.0 (8.25).

The percentage of children categorized as having mild, moderate, and severe caries and their respective severity scores were as follows: 35.24 % – 0; 30.79% – 0,25-6 and 33.97% – 6,25-42 (Figure 1).

In the sample, overall prevalence of oral pain in the previous 30 days was 20.8%. Figure 2 shows the frequency of the oral pain in the previous 30 days

Table 2. Socioeconomic/demographic and toothbrushing frequency sample characteristics.

Variables	Frequency (n)	%
Gender		
Male	252	53.50
Female	219	46.50
Toothbrushing frequency (per day)		
Up to twice (≤ 2)	326	69.21
More than twice (> 2)	145	30.79
Family structure		
Nuclear	289	61.36
Step parent	68	14.44
Single parent	114	24.20
Household		
Father	244	51.80
Mother	157	33.33
Other	70	14.86
Mother's level of education		
Up to incomplete elementary school	113	23.99
Completed elementary school/incomplete high school	105	22.29
Complete high school or greater	253	53.72
Income (minimum wage)		
< 1	150	31.85
1 a 2	183	38.85
> 2	138	29.30
Income per capita (minimum wage)		
< 1	402	85.35
> 1	69	14.65
Type of residence		
Shanty	27	5.73
Brick	444	94.27
Property		
Borrowed	68	14.44
Rented	99	21.02
Ownership	304	64.54

in relation to the child's maximum CAST code. An association between this variable and the most severe stages of carious lesion was observed ($p < 0.0001$).

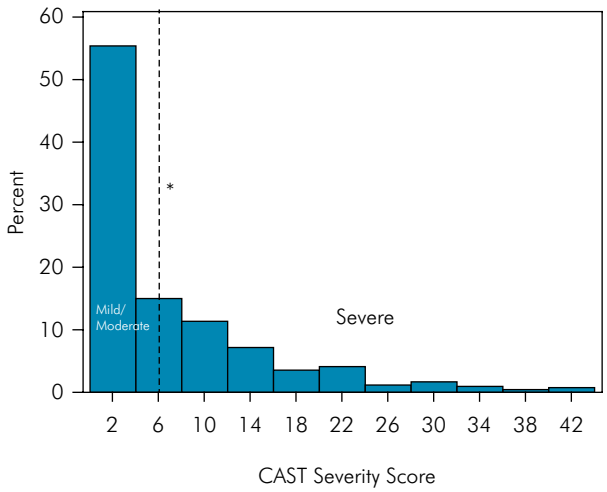
The results of the multivariate analysis are shown in Table 4. It is noted that the mothers' level of education, parents income and the house ownership were the variables related to the prevalence of having oral pain in the previous 30 days.

Upon examining the child's overall oral pain experience, the multivariate analysis showed that mothers' level of education and a family total income were predictors of the problem (Table 4).

In terms of severity of dental caries, the multivariate analysis showed that the mother's level of education and the family ownership of a house were predictive factors for higher CAST

Table 3. Allocation of individuals according to their maximum CAST, including deciduous and permanent teeth, and their respective disease status.

CAST codes and description	Disease status	%	Standard error	95%CI	
				Lower limit	Upper limit
0 (sound)	Healthy	30.79	2.13	26.60	34.97
1 (sealant)	Healthy	0.21	0.21	0.00	0.63
2 (restoration)	Healthy	4.25	0.93	2.42	6.07
3 (enamel lesion)	(Pre) morbidity	6.37	1.13	4.16	8.58
4 (dentin/discoloration)	Morbidity	2.76	0.76	1.27	4.24
5 (dentin/cavitation)	Morbidity	27.39	2.06	23.35	31.43
6 (pulp exposure)	Severe morbidity	15.07	1.65	11.83	18.32
7 (abscess/fistula)	Severe morbidity	1.27	0.52	0.26	2.29
8 (extracted due to caries)	Mortality	11.89	1.49	8.96	14.82



* The dotted line indicates the cutoff between the mild/moderate and severe category.

Figure 1. Histogram showing the sample distribution according to the CAST severity score.

severity scores (Table 3). A prevalence ratio of having a high CAST severity score of 41% (PR = 1.41; p = 0.0077) or greater was found for children of mothers with incomplete high school compared with those of mothers with complete high school or higher educational levels. Moreover, a prevalence of having a high CAST severity score of 30% (PR = 1.30; p = 0.0385) or higher was found for children of parents who did not own their house compared with those who did.

For the presence of substantial biofilm, the predictors determined by the multivariate analysis were low toothbrushing frequency and parents not being homeowners (Table 4).

No association with the variables tested was found between either the family structure or the head of household.

Discussion

The main question raised by this study refers to the relations of family structure and the status of children's oral health, herein defined by the presence of severe tooth decay, substantial presence of biofilm and oral pain. Although some previous studies have tried to answer this question,[19,27] the results have been contradictory, which makes additional investigation necessary. Once a clearer response has been achieved, more effective public policies can be implemented to prevent/control the caries process. These policies are so important for the population in general, but even more necessary for those in conditions of social vulnerability. Overall, for the population under investigation, our findings indicated that there were other variables that played a more important role in their children's oral health than the parents' marital status alone.

As regards the sample profile, 85.35% of the families investigated had an income <1 minimum wage per capita (minimum monthly wage = U$208.67), which is in agreement with the data for these regions (income per capita for Cidade Estrutural and Sol Nascente U$134.64 and U$177.20,

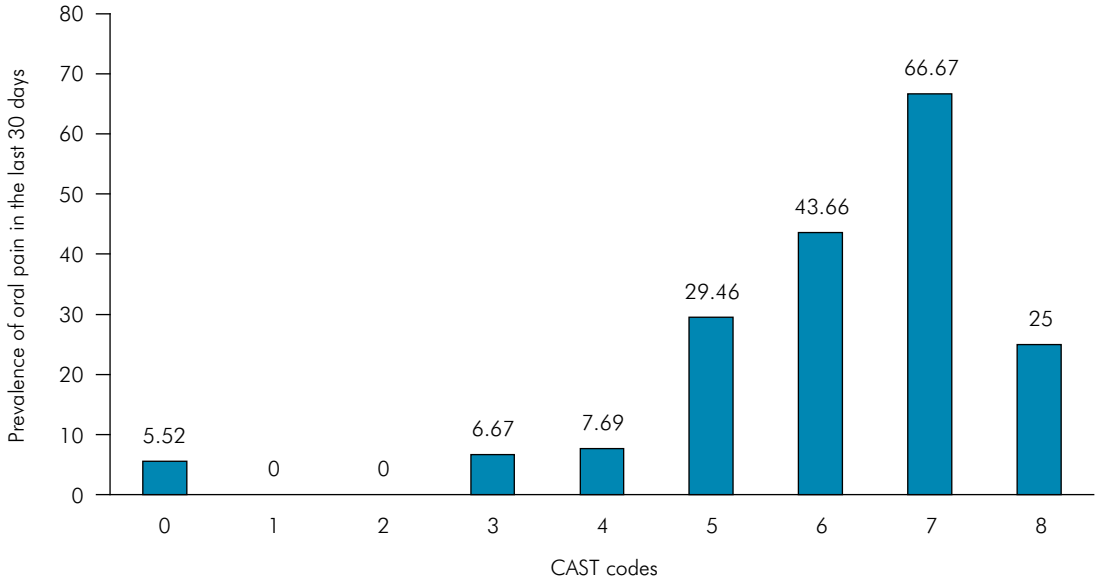


Figure 2. Prevalence of oral pain in the previous 30 days in relation to the maximum CAST score.

respectively).[22] Moreover, only 53.20% of the mothers had completed high school, which is 13.10% lower than the rate for women over 14 years of age in the Federal District.[23] Together, these values show that the population studied could indeed be considered underprivileged.

When the overall children's caries prevalence values in the present investigation were compared with the results of a previous survey also using CAST[25] conducted in Cidade Estrutural with schoolchildren with a mean age of 7.45 (± 0.91), a worrisome outcome was outstanding: the prevalence of untreated carious lesions in the two surveys was similar (43.74% present study vs 49.41% by Ribeiro et al.[25]), although 5 years had passed. Interestingly enough, however, after accounting for enamel lesions, caries prevalence differed considerably: 52.87% in the present investigation versus 69.12% reported by Ribeiro et al.[25] In the present study, the inclusion of Sol Nascente, which represented 53.50% of the sample and in which 95% of the population had access to piped fluoridated water (0.7ppm) in contrast with the 79.27% in Cidade Estrutural, could partly explain this finding. According to the Brazilian National Dental Survey,[14] living in cities with fluoridated water as opposed to those with low fluoride coverage was considered a contextual determinant for caries onset.

Another important variable for determining oral health status is oral pain, which has been positively associated with more severe stages of carious lesions, negatively impacting children's quality of life.[3,28,29] In the present investigation, if the children complained of oral pain, they were asked about the location of the pain. Our results clearly showed that the source of pain was predominately toothache and that the more severe the carious lesion was, the higher was the prevalence of oral pain reported (Figure 2). The 20.8% of prevalence of oral pain in the last 30 days, comparable with the 21.8% reported by Leal et al[28], who assessed toothache in children of similar age and social background but over 10 years ago, supported the theory that the oral health care needs of the two communities in the present investigation were not met to a sufficient extent.

According to our results, only 35.25% of the children were healthy, while the teeth of over 11% of them were already at the mortality stage (tooth loss). Moreover, our data also showed that 36.52% of the children could be moved from the pre-morbidity and morbidity stages to a healthy condition by implementing preventive/curative care. However, as previously mentioned, access to oral health services appeared to be a problem in these two communities. As a result, non-conventional treatment options,

Table 4. Prevalence Ratio (PR) and 95% CI related to substantial presence of biofilm, CAST severity score, oral pain in the previous 30 days and history of oral pain and their significant predictors.

Clinical outcomes	PR Unadjusted (CI 95%)	p-value	PR Adjusted* (CI 95%)	p-value
Substantial presence of biofilm				
Toothbrushing frequency		0.0469		0.0470
Up to twice per day	1.19 (1.00–1.41)	0.0469	1.18 (1.00–1.40)	0.0470
More than twice per day	1	-	1	-
Own residence		0.0481	-	0.0493
Yes	1	-	1	-
No	1.14 (1.00–1.32)	0.1670	1.13 (1.00–1.31)	0.0493
CAST severity score				
Mother's level of education		0.0069		0.0077
Incomplete High School	1.42 (1.10–1.83)	0.0069	1.41 (1.09–1.81)	0.0077
Complete High School or grater	1	-	1	-
Own residence		0.0343		0.0385
Yes	1	-	1	-
No	1.31 (1.02–1.69)	0.0343	1.30 (1.01–1.67)	0.0385
Oral pain in the last 30 days				
Mother's level of education		0.0089		0.0335
Incomplete High School	1.61 (1.13–2.31)	0.0089	1.47 (1.03–2.11)	0.0335
Complete High School or higher	1	-	1	-
Income		0.0038		0.0088
< 1 Minimum wage	1.67 (1.18–2.37)	0.0038	1.59 (1.12–2.25)	0.0088
1 Minimum wage or more	1	-	1	-
Own residence		0.0146		0.0124
Yes	1	-	1	-
No	1.55 (1.09–2.19)	0.0146	1.55 (1.10–2.18)	0.0129
History of oral pain				
Mother's level of education		0.0223		0.0485
Incomplete High School	1.36 (1.04–1.78)	0.0223	1.29 (1.00–1.69)	0.0485
Complete High School or greater	1	-	1	-
Income		0.0041		0.0116
< 1 Minimum wage	1.47 (1.13–1.91)	0.0041	1.41 (1.08–1.83)	0.0116

*Adjusted based on significant predictors.

such as the use of the Atraumatic Restorative Treatment and/or silver diamine fluoride, that have produced excellent results in the management of dental caries, should be implemented in children on the school premises.[30,31]

In the present investigation, we used the CAST severity score to allocate children according to the severity of disease, unlike the majority of studies that used a dmf/DMF ≤ 1 as a threshold.[11,12,14] The use of dmf/DMF has its limitations, mainly

because it does not enable a restored tooth to be differentiated from a decayed tooth, and even when decayed, it does not enable a cavity involving only dentin to be differentiated from one with pulp exposure. However, the CAST severity score is the result of a mathematical formula that accounts for CAST codes 3 to 8 and in which increasingly larger weights are assigned in accordance with higher codes[25]. Thus, children with higher CAST codes are indeed those with the most severe problems. These results confirm the reliability of the CAST severity score, corroborating the findings of previous studies.[25,32] Nevertheless, a decision was made to convert CAST codes into dmf/DMF, to allow the comparison of our data with studies that used/will use these criteria.

Another important variable related to oral health was the presence of biofilm. Oral hygiene habits are one of the behavior factors associated with the development of dental caries,[33] defined as a polymicrobial disease that results from a shift of the supra- and subgingival microbial communities from a healthy to a status of dysbisosis.[34] In the present study, the frequency of toothbrushing was associated with the presence of biofilm, an expected result consistent with the findings of Khalid et al.[35] and Jaiswal et al.[36]

Once the seriousness of the problem is understood, it is important to know which factors pose a threat to the oral health of socially vulnerable children. Relative to this aspect, it was not surprising that different indicators of social level were associated with a child's poor oral health. According to a meta-analysis, lower education level, income, and occupation are significantly associated with a greater risk of having carious lesions/caries experience.[37] The present study corroborated the finding of this review, since we found the prevalence ratio of having a high CAST severity score (> 6) and having had oral pain in the last 30 days to be higher in schoolchildren whose mothers had not completed high school and whose parents lived in a borrowed or rented house. In addition, family income influenced the occurrence of pain. As explained by Schwendicke et al.,[37] parental educational background frequently determines family income, which, in turn, determines access to treatment, home dental care, and good habits regarding food and hygiene.

Ultimately, a lack of association was found between the family structure and the children's oral health, an outcome supported by some studies[11,20,21,27] but refuted by others.[15,17,19] To explain such contradictory findings is not straightforward. According to a systematic review that had the aim of investigating parental influence on the development of dental caries in children, a better understanding of the nature of the relationship between socioeconomic risk factors and parenting behaviors is required, since factors at family-level were likely to interact with SES factors to influence caries development in children.[16] Undoubtedly, for the population included in this study, a strong predictor of poor oral health status was the factor living in a rented or borrowed house, which was consistent with previous research.[38,39] This could be explained, at least partly by the fact that in Brazil, the role played by rent in household expenditure is larger for low-income than for higher income groups. Therefore, the lower the per capita income, the larger would be the part of the family budget spent on rent.[40] It can, therefore, be inferred that less is left for spending on other family needs, including oral health.

This study had some limitations, as it was conducted during the COVID 2019 pandemic after a period of a social isolation when schools were just returning to classes in a hybrid way (face-to-face and remote). This might explain the lack of adherence by some parents. In addition, this was a cross-sectional study, in which it is possible to infer relationships, but not a cause-effect among variables under investigation. Another limitation was the similar socioeconomic level of the population. This may, however, be a strength, as it showed that even for this type of population, there were factors that increased their risk of poorer oral health. These factors should be taken into account when designing public health policies, which should target this specific group of people, providing them with better health education, as well as implementing measures capable of preventing/controlling the disease before it progresses to more severe stages when it becomes more expensive and complex to provide treatment.

Conclusions

For socially vulnerable children, variables related to the socioeconomic status of the families were more relevant than the family structure in terms of their oral health status. In addition to family income, the mother's educational level and home ownership were found to be factors that predicted poorer oral health of the children.

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