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How oral health literacy and parental behavior during the meals relate to dental caries in children

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Abstract: This cross-sectional study aimed to verify the influence of parental behavior on the development of dental caries in children by assessing parents' behavior during their children's meals and their parental level of oral health literacy. This study was conducted with children aged 2 to 4 in Diadema, São Paulo, Brazil. Six hundred and thirty children were examined to assess the prevalence of dental caries (dmft index). Parents answered a questionnaire related to socio-demographic conditions, oral health literacy (OHL), and the parents' behavior during the meal - Parent Mealtime Action Scale - (PMAS). The analysis fitted zero-inflated negative binomial regression (ZINB) models to assess unadjusted and adjusted associations between the study outcome and covariates. In the unadjusted analysis, the child's age, the number of siblings, household crowding, family income, socioeconomic status and OHL were associated with the outcome ($p < 0.05$). In the adjusted model, dental caries was more prevalent among 3- (PR: 1.85, 95%CI: 1.19–2.87) and 4-year-old children (PR: 2.43, 95%CI: 1.60–3.71), those with at least one sibling (PR: 1.66, 95%CI:1.18–2.33). Poor children were more likely to have dental caries (PR: 0.66, 95%CI: 0.48–0.91); the Use of Rewards dimension of the PMAS was associated positively with dental caries severity (RR: 0.90, 95%CI: 0.84–0.97). Although OHL was not associated with caries, parents' mealtime behaviors were related to dental caries. This suggested that communication between parents and children related to good eating practices could play a protective role against dental caries in children.

Keywords: Pediatric Dentistry; Behavior; Education, Dental; Dental Caries.

Introduction

During the last decades, the World Health Organization (WHO) has paid special attention to oral health diseases, especially dental caries.[1] Although its prevalence has declined in several countries, the condition is still considered a significant public health problem, and severe inequalities affect its distribution in the population.[1-3]

Among five-year-old children, the prevalence of untreated caries was 53.4% in the last nationwide epidemiological survey in Brazil,[4] with the dmft reaching 2.43. Furthermore, the decayed component accounted for

over 80% of the index. Many researchers believe that oral health knowledge and parents' attitudes mainly determine and promote children's oral health behavior.[5].

In preschoolers, the risk and vulnerability to dental caries have been associated with factors related to family and lifestyle.[5] Despite the critical role of caregivers in preventing dental caries and promoting children's oral health,[6] few studies have assessed the importance of parents' ability to make appropriate decisions in oral health for themselves and their children.

Oral health literacy (OHL) can be defined as "the degree to which individuals have the ability to obtain, process, and understand basic health information and services necessary to make appropriate health decisions".[7] Considering that children are dependent on their caregivers for access to health care, low adult empowerment has potential detrimental effects on the oral health of the child population[8]. Several studies have assessed the relationship between oral health literacy of parents and the oral health status of their offspring, for example, the prevalence of dental caries in early childhood or preschool age.[8-10]

The influence of parents' behavior on children's diet has not yet been fully clarified in the literature, given the complexity of the topic and the social context in which the child is inserted. A review by Hughes et al.[11] highlighted the importance of paying attention to specific issues: the child´s individual needs, establishing limits on food, and avoiding stringent prohibitions of certain foods or the obligation to eat them. Several studies[11-13] have examined the relationship between parenting styles and children's eating habits. However, to our knowledge, no study has evaluated whether the low level of oral health literacy of parents or caregivers could contribute to inappropriate behavior during their children's meals.

Parenting styles are psychological constructs involving attitudes and approaches to raising children

n used in the family and society. The literature classifies parenting styles into four categories (authoritarian, authoritative, permissive, and uninvolved). In the first style, authoritarian, there is no dialogue between the parties or concern for the child's autonomy and desire. The authoritative style is characterized by a sensitive and affectionate behavior to the needs of children through mutual respect and dialogue. In the permissive style there is difficulty in imposing limits and restrictions on cariogenic foods thus allowing children to control their behavior alone. The fourth parenting style, negligent or uninvolved is characterized by the lack of control and involvement with the children's educational process.[11]

Our study aimed to assess the influence of parental behavior on the development of children's dental caries by evaluating parents' behavior during their children's meals and their level of literacy in oral health, considering that an adequate degree of OHL could contribute to healthier habits. We hypothesized that low parental literacy and parents' poor behavior during meals would be associated with dental caries in children.

Methodology

Study design

This cross-sectional population-based study was approved by the Research Ethics Committee (68445317.3.0000.0075) of the School of Public Health of the University of São Paulo. All parents/caregivers received information regarding the aim of the study and signed Terms of Free and Informed Consent.

Study population and data collection

Data collection occurred in 2017, entailing a population-based sample of children living in Diadema, São Paulo, Brazil. The sample size calculation considered estimations with standard errors of 5%, a design effect of 2.0, 95% confidence intervals, and 20% potential non-response rate. The prevalence of dental caries in preschool children was set at 20,3%.[15] The aim was to recruit 597 pairs of children and parents or caregivers. The selection of participants observed a systematic draw among all children attending a one-day national child vaccination campaign. The enrollment of the sample included all the 18 health centers in Diadema, each one accounting for a specific administrative division of the city. For children, inclusion criteria considered the absence of orthopedic or orthodontic devices, no systemic diseases, and no

particular learning disabilities. For parents, fluency in Portuguese and reading ability was necessary. The oral examination of children and a face-to-face interview with their parents or caregivers occurred during the vaccination campaign, after having explained the study objectives and obtaining the written consent.

Children's oral examination

The clinical oral examination was performed in accordance with procedures standardized by the World Health Organization (WHO) criteria.[16] Children were examined at a dental unit using a guiding light, a 3 in 1 syringe, plane dental mirrors, and a periodontal probe for detection of cavitation only. Cotton rolls and gauze were available for removing moisture and plaque when necessary. The purpose of the examination was to determine the prevalence of dental caries and the dmft index, expressing the number of primary teeth with decay, extracted due to caries, or filled. Eighteen previously calibrated examiners, one at each health center in Diadema, independently performed the children's oral examinations. All examiners were graduate dentists with previous experience in previous epidemiological surveys. They underwent two five-hour sessions of training and calibration exercises, with an interval of one week between sessions and the assessment of intra- and inter-examiner reliability. Kappa statistics were calculated on a tooth-by-tooth basis. Kappa coefficients ranged between 0.98 and 0.85 for intra- and inter-examiner reliability, respectively.

Parental behavior assessment

Parental behavior was evaluated based on the parents' behavior during the children's meal and according to their parental OHL level. For this assessment, we applied two instruments: Breald-30 and PMAS.

BREALD-30 instrument

The Brazilian version of the Rapid Estimate of Adult Literacy in Dentistry – 30 (BREALD-30)[17] was used to assess the oral health literacy of the children's parents/caregivers. The BREALD-30 contains 30 words related to oral diseases arranged in increasing order of reading difficulty. The words were typed on an A4-size sheet of paper with bold Times-Roman fonts, size 12. Participants were asked to clearly say the words in the instrument out loud. One point was assigned to each word pronounced correctly without any hesitation. The scores were then summed up to obtain the literacy score for the individual. Pronunciation errors were considered when the participants read the words slowly and without rhythm and when they needed to repeat the word or any syllable of it.

PMAS instrument

The Brazilian version of the Parent Mealtime Action Scale (PMAS)[18] was used to assess the parents' behavior during the meal. This instrument is a self-administrated scale with 31 topics subdivided into nine domains of eating practices: a) daily fruit and vegetable (FV) availability; b) snack modeling; c) use of rewards; d) many food choice; e) fat reduction; f) snack limits; g) positive persuasion; 10) insistence on eating. A scaled score from one to three points (1 = never, 2 = sometimes, and 3 = always) referred to the frequency with which the respondents adopted each of the 31 actions listed in the PMAS. Higher scores denoted a greater frequency of the behavior of parents/caregivers relative to the dietary education of their children.

Eighteen community health agents, who were blind to the clinical oral examinations, conducted the interviews. They were trained in the reading and intonation of each question and response option of the BREALD-30 and PMAS instruments. Socio-demographic conditions such as parental age, the number of siblings, and family income were collected as discrete quantitative variables. In contrast, parents' educational level and household crowding were collected as ordinal and nominal qualitative variables, respectively, subsequently dichotomized. Socioeconomic status was assessed using a questionnaire 19 with the following questions: a) the number of rooms and characteristics of the household (bathrooms, housekeeper, automobiles, microcomputers, freezer, dishwasher, microwave, motorcycle, and tumble dryer); b) schooling of the head of the household; c) access to public services. The resulting score had seven categories corresponding to

social classes A1, A2, B1, B2, C, and DE, which were subsequently reclassified dichotomously (A1-B1 and B2-E). Socio-demographic data were categorized for statistical analysis: parents' age (≤ 30 and > 30 years) and parents' schooling (≤ 10 and > 10 years). Family income was categorized in terms of the Brazilian minimum wage (BMW), which corresponded to US$ 246.51 per month during the period of data collection (classified as < 2 BMW and ≥ 2 BMW).

Data analysis

Initially, descriptive analyses were performed to obtain the frequency distribution of all variables. Caries prevalence referred to having or not having at least one deciduous decayed tooth; caries severity referred to the number of deciduous teeth affected.

The analysis fitted zero-inflated negative binomial regression (ZINB) models. This modality allowed for assessing unadjusted and adjusted associations between the study outcome and covariates such as the BREALD and PMAS. These associations were evaluated in terms of prevalence ratios (PR), considering the outcome as a dichotomous variable, and rate ratios (RR) in assessing severity, considering the dmft as a count variable. Confidence Intervals of 95% (95% CI) were calculated for both the PR and RR.

For fitting zero-inflated models, selected multiple regression covariates were previously assessed in the unadjusted analysis. The multivariable model was based on a conceptual framework (Figure). The input of the variables followed the order of the levels, i.e., more distal covariates adjusted the assessment of proximal covariates. Demographic covariates adjusted the association of socioeconomic covariates; both adjusted the evaluation of health literacy, which, in turn, adjusted behavioral characteristics. Covariates with a p-value lower than 0.20 in the unadjusted analysis were considered for the final adjusted model; having a p-value lower than 0.05 was the criterion to maintain the covariate in the model. All statistical analyses were performed using Stata 15.

Results

Overall, 630 children participated in the study, thus accounting for a 100% response rate. The majority of children were boys (52.7%), and their average age (standard deviation) was 2.98 (0.03) years. All parents/caregivers interviewed in this study completed the BREALD and PMAS questionnaires (positive response rate of 100%); all questionnaires were fully completed without any missing data. There were no "do not know" responses.

Table 1 shows the socio-demographic and clinical characteristics of the sample. As regards the experience of untreated caries, 24.0% of children had dental caries, and 80.8% of them brushed their teeth two or more times a day.

Relative to parents' schooling, 63% had the equivalent of 10 years of education; 85.4% of parents/caregivers had an ideal BREALD score (85.40%), considering the cut-off point of <13 to indicate a

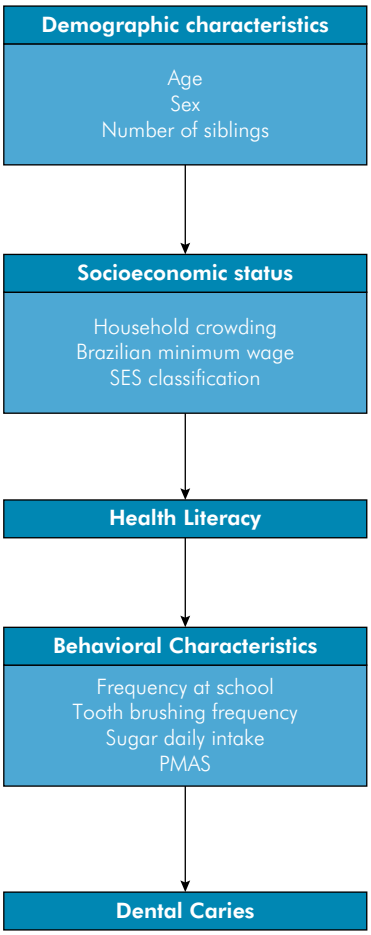

Figure. Conceptual hierarchical framework of risk factors for dental caries.

Table 1. Socio-demographic and oral health characteristics of the sample.

Demographic characteristics	n (%)
Age	
2 years	213 (33.81)
3 years	213 (33.81)
4 years	204 (32.38)
Sex	
Female	298 (47.30)
Male	332 (52.70)
Number of siblings	
None	272 (43.17)
1 or more	343 (54.44)
Socioeconomic status	
Mother's level of education	
≤ 10 years of schooling	219 (34.76)
> 10 years of schooling	401 (63.65)
Mother's age	312 (49.68)
≤ 30 years	314 (50.00)
> 30 years	
Father's age	198 (31.43)
≤ 30 years	382 (60.63)
> 30 years	
School frequency	
Yes	452 (71.75)
No	154 (24.44)
Family income	
Up to 2 minimum wage	315 (50.00)
≥ 2 minimum wage	296 (46.98)
Socioeconomic stratum	
A1+A2+B1	200 (31.75)
B2+C1+C2+D-E	429 (68.10)
Household crowding (mean ± sd)	1.14 (0.024)
< 1	355 (56.35)
> 1	244 (38.73)
Oral health characteristics	
Frequency of sugar consumption	
< 3 times a day	260 (41.27)
> 3 times a day	365 (57.94)
Tooth brushing	
≥ 2 a day	509 (80.79)
< 2 a day	106 (16.83)
Untreated caries experience	
Absence	479 (76.04)
Presence	151 (23.97)
BREALD	
Low	90 (14.29)
Ideal	538 (85.40)
(mean ± sd)	19.27 (0.26)

Number of missing subjects: number of siblings: 15; mother's level of education: 10; mother's age: 4; father's age: 50; school frequency: 24; family income: 19; socioeconomic stratum: 1; household crowding: 31; frequency of consumption of sugar: 5; tooth brushing: 15; BREALD: 2.

"low" level of literacy in oral health. The BREALD index ranked 19.27, standard deviation 0.26 (Table 1); it ranged from 0 to 30, with a median 20 and an interquartile range of 16–24.

In the unadjusted analysis of factors associated with dental caries prevalence, the child's age, the number of siblings, household crowding, income, socioeconomic status, and oral health literacy were associated with the outcome ($p < 0.05$). The unadjusted analysis of caries severity was only associated with the PMAS instrument (Table 2).

In the adjusted model, dental caries was more prevalent among 3- (PR: 1.85, 95%CI:1.19–2.87) and 4-year-old children (PR: 2.43, 95%CI:1.60–3.71), those with at least one sibling (PR: 1.66, 95%CI: 1.18–2.33). However, children whose parents/caregivers earned ≥ 2 BMW were less likely to have dental caries (PR: 0.66, 95%CI: 0.48–0.91). In the adjusted model, the Use of Rewards dimension of the PMAS remained associated positively with dental caries severity (RR: 0.90, 95%CI: 0.84–0.97). The child's age, three years (PR: 1.75; $p = 0.012$), four years (PR: 2.41; $p < 0.001$) and having one or more siblings (PR: 1.61; $p = 0.006$) was associated with dental caries. In contrast, parents/caregivers with ideal levels of health literacy (PR: 0.66; $p = 0.045$) were associated with a lower prevalence of caries in preschool children. Concerning the severity of dental caries, children with one or more siblings had a worse condition (RR: 1.40; $p = 0.039$) (Table 3).

Oral health literacy lost significance in the adjusted model because the entry of income had already explained the difference of caries between socioeconomic status. Health literacy also had a socioeconomic bias, with strata of better social status ranked as more favorable indicators of health literacy.

Discussion

This current study aim was to evaluate the association between dental caries in preschoolers in Brazil and the oral health literacy of parents/caregivers and their behavior during their children's meals, as assessed by all domains of the PMAS questionnaire. Although a previous study[20] had previously established

Table 2. Association between BREALD-30, PMAS, sociodemographic and behavioral conditions, and dental caries prevalence and severity – unadjusted model.

Variables	Prevalence		Severity	
	PR (95% CI)	p-value	RR (95% CI)	p-value
Demographic characteristics				
Child's age				
2 years	Ref.			
3 years	1.80 (1.16–2.80)	0.008	0.80 (0.48–1.35)	0.412
4 years	2.49 (1.64–3.79)	< 0.001	1.11 (0.68–1.82)	0.660
Child's sex				
Male	Ref.		0.97 (0.67–1.40)	
Female	1.02 (0.75–1.39)	0.894		0.865
Number of siblings				
None	Ref.			
One or more	1.74 (1.24–2.44)	0.001	1.17 (0.79–1.73)	0.426
Socioeconomic characteristics				
Mother's level of education				
≤ 10 years of schooling	Ref.			
> 10 years of schooling	0.801 (0.58–1.11)	0.187	0.77 (0.53–1.13)	0.193
Mother's age				
≤ 30 years	Ref.			
> 30 years	0.98 (0.72–1.33)	0.904	1.03 (0.71–1.49)	0.877
Father's age				
≤ 30 years	Ref.			
> 30 years	1.23 (0.87–1.76)	0.23	1.16 (0.76–1.77)	0.489
School frequency				
Yes	Ref.			
No	0.75 (0.51–1.11)	0.149	1.21 (0.77–1.89)	0.409
Household crowding				
Up to one	Ref.			
More than one	1.40 (1.01–1.92)	0.039	1.13 (0.77–1.65)	0.541
Brazilian minimum wage				
< 2 BMW	Ref.			
≥ 2 BMW	0.73 (0.53–0.99)	0.049	0.74 (0.51–1.08)	0.126
SES classification				
A – B1	Ref.			
B2 - E	1.50 (1.05–2.17)	0.027	1.43 (0.92–2.22)	0.114
Health literacy				
BREALD-30				
Low	Ref.			
Ideal	0.65 (0.43–0.97)	0.035	1.03 (0.63–1.67)	0.903

Continue

Behavioral characteristics				
Frequency at school				
No	Ref.			
Yes	0.75 (0.50–1.10)	0.149	0.52 (–0.02–1.05)	0.06
Tooth brushing frequency				
≥ 2	Ref.		Ref.	
< 2	0.75 (0.50–1.10)	0.149	1.17 (0.75–1.83)	0.479
Daily sugar intake				
≤ 3	Ref.		Ref.	
> 3	1.02 (0.75–1.40)	0.875	0.92 (0.63–1.34)	0.659
PMAS				
Daily fruits and vegetables	1.03 (0.92–1.16)	0.531	1.01 (0.87–1.15)	0.936
Snack modelling	1.11 (0.99–1.23)	0.063	0.99 (0.88–1.11)	0.872
Use of rewards	1.00 (0.93–1.08)	0.935	0.90 (0.84–0.97)	0.005
Many food choices	1.01 (0.93–1.10)	0.767	0.92 (0.84–1)	0.059
Fat reduction	0.94 (0.86–1.03)	0.215	0.98 (0.88–1.09)	0.701
Special meals	1.05 (0.94–1.18)	0.381	0.89 (0.78–1.01)	0.072
Snack limits	0.99 (0.91–1.07)	0.767	1.01 (0.91–1.12)	0.800
Positive persuasion	0.95 (0.89–1.02)	0.138	1.02 (0.93–1.12)	0.650
Insistence on rating	0.98 (0.91–1.05)	0.535	1.04 (0.95–1.13)	0.361

this relationship, it exclusively had focused on the consumption of snacks.

Among the PMAS dimensions, the "Use of Rewards" was significantly associated with lower severity of dental caries. This finding was compatible with the hypothesis that the communication between parents and children provided adequate protection because this dimension consisted of encouraging good eating practices via rewards such as favorite food, toys, and special activities. Furthermore, restrictive feeding practices can contribute to increasing the interest of children in those prohibited foods.[21] Hence, knowledge of parenting styles allows for addressing children's unhealthy eating habits. The literature[22,23] has shown that sensitive and affectionate parenting behaviors were associated with a positive impact on diet in children.

Healthy eating habits can result from children's perception of their parents' guidance, thus contributing to lower risk of caries. Hendy et al.[24] stated that non-nutritional rewards are preferable because offering food rewards may reduce the interest of children in vegetables and fruits. Choosing appropriate rewards is a complex task that can impact the child's eating preferences. Moreover, it is an instance of positive practices related to parents' oral health literacy. Parents with an appropriate level of OHL are in better conditions to understand the importance of healthy practices and their influence on oral health.

The remaining dimensions of the PMAS index, such as the consumption of snacks, were not significantly associated with caries prevalence and severity in the sample. This finding suggested that the effect of parents' mealtime action scale on the risk of dental caries in children may occur in the longer term. This study exclusively enrolled children from two to four years old; we hypothesized that the cumulative effect of parents' behavior during the meals demanded a longer time interval to reach statistical significance.

OHL is a critical tool for health promotion and prevention of oral diseases as it allows the measurement of inequalities in oral health. OHL

Table 3. Association between BREALD-30, PMAS, sociodemographic and behavioral conditions, and dental caries prevalence and severity – adjusted model.

Variables	Prevalence		Severity	
	PR (95% CI)	p-value	RR (95% CI)	p-value
Demographic characteristics				
Child's age (years)				
2	Ref.		**	
3	1.85 (1.19–2.87)	0.006		
4	2.43 (1.60–3.71)	< 0.001		
Number of siblings				
None	Ref.		**	
One or more	1.66 (1.18–2.33)	0.003		
Socioeconomic characteristics				
Brazilian minimum wage				
< 2 BMW	Ref.		**	
≥ 2 BMW	0.66 (0.48–0.91)	0.011		
Behavioral characteristics				
PMAS				
Daily fruits and vegetables				
Snack modelling	1.11 (0.99–1.23)	0.055		
Use of rewards			0.90 (0.84–0.97)	0.005
Many food choices				
Fat reduction				
Special meals				
Snack limits				
Positive persuasion				
Insistence on eating				

relates to the "ability of individuals to gain access to, understand, and use information in ways which promote and maintain good health.[25]" Individuals with low health literacy skills often have less health information, lower health status, more unhealthy behaviors, and make less use of preventive services.[26] Few studies have addressed the relationship between literacy and oral conditions, explicitly addressing the occurrence of dental caries.[27-29] A systematic review[29] concluded that low parental OHL was associated with dental caries among their children, consistent with the result reported here of association between the dental caries prevalence and OHL in the unadjusted model.

In the adjusted model, our study also showed a significant association between dental caries and demographic characteristics (age and number of siblings) and socioeconomic status (income). Dental caries was associated with all socioeconomic variables assessed in this study. Socioeconomic inequalities in oral health, specifically with reference to the association between caries and socioeconomic status, have extensively been acknowledged.[30] Family income, parents' schooling level, and occupational status were inversely associated with dental caries in over half of the studies included in a systematic review.[31] The correlation between family income and risk of dental caries reinforces the importance of assessing socioeconomic conditions in studies on oral health. Socioeconomic inequalities are a critical aspect influencing oral health, and individuals from less privileged strata are more

vulnerable to the development of oral diseases, dental caries in particular.[32]

The association between dental caries and the number of siblings suggests that larger families may have more difficulties providing appropriate attention to and care for their children. This hypothesis considers that the family plays a critical role in children's oral health. In the same way that a family environment with healthy oral habits can positively impact the oral health behavior of children, the opposite may occur and result in impaired oral health. Indeed, previous studies have found that families with more children had higher rates of caries prevalence.[33]

Age was also significantly related to the manifestation of dental caries. The older the children, the more susceptible they were to have developed some caries lesions previously, which can be due to the cumulative effect of factors that contribute to caries progression.[34] Therefore, previous caries experience might predict the development of new caries lesions in children.

The findings of our study should be considered within the context of certain limitations. Firstly, it had a cross-sectional design, which does not allow for establishing temporal relations and causal inferences between factors and outcomes. Secondly, an important aspect of the PMAS tool is the risk of underreporting undesired behaviors. Parents may answer the questions according to the behaviors that they believe researchers would expect hear from competent caregivers. As far as the BREALD instrument is concerned, the data collection tool is limited to solely evaluating the recognition of words and the ability to read them. The assessment of literacy does not include knowledge of the concepts or the meaning of the words, which limited the evaluation of the parents' literacy level. Thus, the future inclusion of additional and more complex assessment tools may produce a more in-depth analysis. However, it is important to highlight some relevant points of the study such as the importance of communication in parental behavior during meals (parenting styles) and its impact on children's oral health. Furthermore, our study reinforces the need to promote healthy oral behaviors in children' and parental attitudes at mealtimes.

Conclusion

This study reported the association between parental OHL and dental caries in preschool children. This association lost statistical significance after adjusting for income. This result suggested that parental OHL somehow overlaps socioeconomic status in explaining the more unsatisfactory oral health outcome among children in deprived families. Age of the children, the number of siblings, and family income were associated with dental caries. Among the PMAS dimensions, the "Use of Rewards" was a protective factor against dental caries in children.

Finally, the importance of intervention studies to improve parents' oral health literacy is undeniable. Moreover, we reinforced the need for awareness of good eating practices and healthy behaviors related to oral health. We also expect that our findings may contribute to dental care programs focusing on children's oral health and parent's mealtime behavior.

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