Risk indicators of caries lesion activity in children

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DOI 10.23804/ejpd.2019.20.03.02

Abstract

Aim Determine the risk indicators of caries lesion activity in a child sample from Porto Alegre, Brazil.

Materials and methods Study design: cross-sectional study included 97 individuals aged between 3 and 12-years who sought treatment at the Paediatric Clinic at the Dental Teaching Hospital at the Federal University of Rio Grande do Sul, between 2017 and 2018. Questionnaires recorded sociodemographic data, frequency of sugar intake, and toothbrushing frequency. Clinical examination included the visible plaque index, gingival blood index, and caries lesion activity.

Results The mean of surfaces with active caries lesions was 9.81 (IC 95% = 8.47–11.15). Children who presented a frequency of sugar intake of twice/day (PR = 1.62, IC 95% = 1.30–2.03), three times/day (PR = 1.68, IC 95% = 1.37–2.08), and four or more times/day (PR = 1.59, IC 95% = 1.26–2.01), were likely to have active lesions. Ages between 8 and 12-years were associated with a lower probability of active carious lesions (PR = 0.77, IC 95% = 0.66–088). Statistics: Poisson regression analysis was used to estimate the child's relative risk of developing new active caries lesions.

Conclusions The monitoring of sugar intake should be considered a strong instrument for the strategies of control of dental caries in children.

KEYWORDS Dental Caries; Diet; Cariogenic food; Oral Hygiene.

Introduction

Dental caries is a chronic disease, biofilm and diet-dependent, with multifactorial aetiology [Fejerskov et al., 2015]. It is known to be the most common progressive childhood disease, being a serious problem for public health worldwide [Waggoner, 2015]. Dental caries is associated with different risk and indicator factors. The most established in the literature are: past caries experience, enamel defects, dental biofilm, oral hygiene, diet, mother's educational level, and socioeconomic status [Lopes et al., 2014].

Understanding the dynamic nature of the caries process increases the importance of clinically assessing the status of the lesion [Nyvad and Fejerskov, 1997]. The need for diagnosis and evaluation of caries lesion activity is crucial because it defines the treatment's management. The stopping of an active lesion is mainly due to adequate oral hygiene, diet control, fluoride, and invasive treatments, if required. Studies have shown an association between the presence of lesions and a lower frequency of toothbrushing [Silva et al., 2006] and between the consumption of cariogenic foods and high caries risk [Peres et al., 2005]. An increase in dental caries prevalence as age increases has also been shown [Silva et al., 2006; Su et al., 2018].

Although dental caries has been declining significantly in recent years, there are still specific population groups that are at high risk of developing the disease. The study of risk factors and indicators becomes relevant for the development of strategies that may reduce the incidence of caries, especially regarding the status of the lesion. Thus, the objective of the present study was to determine risk indicators of caries lesion activity in a child population from Porto Alegre, southern Brazil.

Subjects and methods

Study design and sampling procedure

Data pertaining to 97 children who participated in a triple-blind placebo randomised controlled clinical trial conducted between 2017 and 2018 on 3 to 12-year-old children who sought treatment at the Pediatric Clinic of the Dental

Teaching Hospital at the Federal University of Rio Grande do Sul, Porto Alegre, southern Brazil (Ethics Committee Approval 2.224.755 and Brazilian Clinical Trials Registry RBR-37V5S3) participated in this cross-sectional study. To be included, they had to have at least one initial enamel lesion on a smooth or occlusal surface in deciduous or permanent dentition, full access to fluoride water (0.7 ppm F), and use a standard fluoride dentifrice (>1000 ppm F). Neither children with systemic alterations that could interfere with the development of caries nor children who had received topical fluoride applications in the previous 6 months were included.

Training and calibration

Clinical examination was performed by two properly trained and calibrated dentists (GMG and NCS). The training of visual-tactile clinical examination was done through photographs with a discussion of doubtful points until consensus was reached. The calibration of the visual-tactile clinical examination was done through the examination of 15 patients with a weekly interval, supervised by an experienced calibrated examiner (gold standard JAR).

The intra- and interexaminer reproducibility was calculated using the Cohen's kappa coefficient, with the minimum value required being 0.70 (kappa value 0.77).

Clinical examinations

The two previously trained and calibrated dentists performed clinical examinations at the Pediatric Clinic at the Dental Teaching Hospital. Oral hygiene was assessed by recording the visible plaque index (VPI) [Ainamo and Bay, 1975] and gingival blood index (GBI) [Ainamo and Bay, 1975]. Prophylaxis was performed with dental floss, rubber cup on smooth surfaces, Robson brush on occlusal surfaces, and 1100 ppm F dentifrice.

Detection of lesions was performed with visual-tactile examination with a clean, dry, and illuminated surface under relative isolation. Patients' visual examination of caries lesions was carried out after teeth cleaning.

Dental caries was recorded based on two indexes of evaluation of caries extent/severity and activity: International Caries Detection and Assessment System (ICDAS) [2007] complemented by Nyvad Criteria [1999]. All active lesions, noncavitated and cavitated, were recorded and considered active lesions for this study. A questionnaire for personal data collection was answered by the responsible adult followed by a 24-hour dietary diary to access children's diet.

Statistical analysis

Data were analysed using IBM SPSS Statistics version 22.0. The analysed variables were age, mother's educational level, toothbrushing frequency, sugar intake frequency, VPI, and GBI.

Poisson regression analysis was used to estimate the child's relative risk of developing new active caries lesions. For the multivariate model, all variables with $p < 0.25$ were included. The significance level was set at 5%.

Results

In this child sample, 97 subjects were examined. The mean age was 7.38 years (IC = 6.90–7.85 ± SD 0.24). The average of active lesions (noncavitated and cavitated) was 9.81 (IC = 8.47–11.15). The decayed, missing, filled teeth (DMFT) index mean was 4.39 (IC = 3.71–5.06).

Variable	n	Active Lesions	
		Mean	SD
Age			
≥3–≤8	64	10.68	0.89
>8–≤12	33	8.12	0.93
Mother's educational level			
1–2	24	9.41	1.19
3–4	57	10.45	0.92
5–6	16	8.12	1.69
Toothbrushing frequency			
1x/day	13	9.30	2.03
2x/day	40	10.60	1.06
≥ 3x/day	44	9.25	0.97
Frequency of sugar intake			
0–1x/day	18	6.33	1.21
2x/day	23	10.65	1.71
3x/day	37	10.72	0.95
≥ 4x/day	19	10.31	1.54
Visible Plaque Index (VPI)			
0-20%	49	8.91	0.78
>20%	48	10.72	1.10
Gingival Blood Index (GBI)			
0–10%	79	10.13	0.76
>10%	18	8.38	1.37
Total	97	9.81	0.67
SD = Standard Deviation			

TABLE 1 Sample's distribution and the active lesions average according to sociodemographic and clinical variables.

Table 1 shows the sample's distribution and the active lesions average according to sociodemographic and clinical variables. A lower number of active lesions is observed when there is a higher mother's educational level, as well as when toothbrushing is performed more than or equal to three times/day. Besides, it can be observed that once-a-day sugar intake is related to a lower number of active lesions, however it increases according to the increase of sugar intake. The number of active lesions is also higher when there is a VPI higher than 20%.

Table 2 shows the association between the number of active lesions and sociodemographic and clinical variables. Age and frequency of sugar intake were the variables that exhibited a statistically significant association in the multivariate model. Ages between 8 and 12-years could be considered as a protective factor for the outcome, and frequency of sugar intake might be considered a risk factor for developing active lesions.

Discussion

The present study reported the risk indicators of caries lesion activity in a child population from Porto Alegre,

Variable	Univariate Model			Multivariate Model		
	PR	95% IC	P	PR	95% IC	P
Age						
≥3–≤8	1.00			1.00		
>8–≤12	0.75	0.65-0.87	<0.001	0.77	0.66-0.88	<0.001
Mother's educational level						
1–2	1.00					
3–4	1.11	0.95-1.29	0.18			
5–6	0.86	0.69-1.07	0.18			
Toothbrushing frequency						
1x/day	1.00					
2x/day	1.13	0.93-1.39	0.20			
≥ 3x/day	0.99	0.81-1.21	0.95			
Frequency of sugar intake						
0-1x/day	1.00			1.00		
2x/day	1.68	1.34-2.10	<0.001	1.62	1.30-2.03	<0.001
3x/day	1.69	1.37-2.08	<0.001	1.68	1.37-2.08	<0.001
≥ 4x/day	1.62	1.29-2.05	<0.001	1.59	1.26-2.01	<0.001
Visible Plaque Index (VPI)						
0-20%	1.00					
>20%	1.20	1.05-1.36	0.004			
Gingival Blood Index (GBI)						
0–10%	1.00					
>10%	0.82	0.69-0.98	0.03			
PR = Prevalence Ratio						

TABLE 2 Association between the number of active lesions and the sociodemographic and clinical variables (Poisson Regression).

southern Brazil. The analysed variables were age, mother's educational level, frequency of sugar intake, toothbrushing frequency, VPI, and GBI. The outcome was the number of cavitated and noncavitated active lesions. Age and frequency of sugar intake were the only variables that were found to be statistically associated with caries activity after multivariate analysis.

The vast majority of existing studies on risk and indicator factors for dental caries only assess the prevalence of caries, the presence of lesions, without assessing caries lesion activity. Thus, the comparisons made in this discussion deserve attention.

Ages between 8 and 12-years could be considered as a protective factor for the outcome. Studies affirmed that dental caries prevalence increases as the age increases [Silva et al., 2006; Su et al., 2018], but they analysed children aged between 2 and 6 years and in this age range parents and caregivers are responsible for the oral hygiene of the children. Martins et al. [1999] state that children must be supervised daily by a caregiver up to 7 or 8-years old, but Faustino-Silva et al. [2008] showed that most mothers believe that children aged between 1 and 3 years would be able to perform their oral hygiene alone. Based on these findings, one may think that when parents are responsible for the oral hygiene of their children, it is not properly performed. And when children already have conditions to perform it alone, it could improve. This hypothesis could justify the findings of the present study.

The age results also can be associated with the toothbrushing frequency. A systematic review and meta-analysis that evaluated the effect of toothbrushing frequency on incidence and increment of carious lesions concluded that individuals who brush their teeth infrequently are at greater risk for the incidence or increment of new carious lesions than those brushing more frequently. The effect is more pronounced in the deciduous than in the permanent dentition [Kumar et al., 2016]. Silva et al. [2007] showed an association between the presence of lesions and a lower frequency of brushing, pointing out that the lack of adequate brushing may favor the appearance of caries

lesions in this population. Vanobbergen et al. [2001] and Gizani et al. [1999] also observed an association between toothbrushing frequency and caries.

The frequency of sugar intake may be considered a risk factor for the number of active lesions, increasing the number as the frequency increases. A cross-sectional study with preschool children showed a positive association between the frequency of extracellular nondairy sugar consumption and the mean DMFT index. The index increased with the consumption of extracellular nondairy sugar [De Souza Filho et al., 2010]. A systematic review showed consistent evidence of moderate quality supporting a relationship between the amount of sugars consumed and dental caries development [Moynihan and Kelly, 2014], as well as a review that showed a positive correlation between the frequency of sugars consumption and caries increase [Sheiham and James, 2015].

According to recent studies, dental caries is associated with different risk factors and predictors and the most consolidated are: past caries experience, enamel defects, dental biofilm, diet, mother's educational level, and socioeconomic status [Lopes et al., 2014; Corrêa-Faria et al., 2016]. A longitudinal association between caries outcomes and modifiable risk factors found that greater toothbrushing frequency and high socioeconomic status were significantly associated with fewer new noncavitated caries [Chankanka et al., 2011]. In the present study, a lower number of active lesions was observed when there is a higher mother's educational level. The number of active lesions is higher when there is a VPI higher than 20%, in agreement with the literature.

The reason for having fewer lesions when the GBI was greater than 10% could be explained by Feldens et al. [2006], who argued that the association between VPI and GBI in children is weaker than the association found in adults. The authors show that many children did not present a measurable GBI, although the average percentage of VPI was high. They also suggest that the degree of gingivitis in children is not directly associated with the VPI, but with other factors such as plaque microbial composition, differences in immunity, and the anatomy of deciduous teeth.

As a conclusion, age and sugar intake frequency can be considered risk indicators of caries lesion activity in this children's population. Age is a protective factor and sugar intake is a risk factor. The monitoring of sugar intake must be considered a strong instrument for the strategies of activity management of dental caries in children.

Acknowledgements

We thank the National Coordination of Post-Graduate Education (CAPES), Pro-Rectory of Research of the Federal University of Rio Grande do Sul (PROPESQ), DFL Brazil, and Colgate/Palmolive, Brazil for support.

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