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Original Article

Dental Erosion in Brazilian Children with Gastroesophageal Reflux Disease

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Abstract

Objective: To evaluate the occurrence of dental erosion (DE) in children with gastroesophageal reflux disease (GERD) and to analyse its association with diet, oral hygiene, socio-demographic characteristics and medical history. **Material and Methods:** The study sample consisted of 43 children (2-14 years) with a positive diagnosis of GERD after 24-hour pH monitoring. Dental erosion was assessed by one trained examiner using the O'Sullivan index. A questionnaire was completed by parents, which provided information on dietary habits, oral hygiene, socio-demographics and medical history of the children. Data analysis was performed using a chi-square test and Poisson regression ($p < 0.05$). **Results:** Dental erosion was diagnosed in 25.6% (N=11) of children. The most affected surfaces were the palatal and incisal (62.1%, N=18). Socio-demographic characteristics and dietary habits were not associated with dental erosion occurrence. The regression model showed that children who used adult toothpaste (PR 4.98, 95% CI 1.34 -18.51) and asthma medication (PR 3.65, 95% CI 1.24 -10.70) had a higher risk of dental erosion. **Conclusion:** Dental erosion in children with GERD was associated with the use of adult toothpaste and asthma medication.

Keywords: Gastroesophageal Reflux; Erosion; Children.

Introduction

Gastroesophageal reflux disease (GERD) is a condition that develops when the stomach reflux causes persistent symptoms and complications. Heartburn and regurgitation are common symptoms of GERD [1]. Among the conditions associated with GERD are chronic cough, laryngitis, asthma and dental erosion (DE) [1,2]. Dental erosion is the irreversible loss of dental hard tissue due to an acid dissolution process that does not involve acids of bacterial origin [3]. GERD patients are at risk of developing dental erosion due to intrinsic acid exposure of teeth [4]. The clinical signs of dental erosion can assist in the diagnosis of gastroesophageal reflux because it is an oral manifestation of the condition [5]. Individuals with GERD are at risk of dental erosion development by the intrinsic chemical agent, although other behavioural and biological factors can also influence occurrence.

Despite the growing interest in epidemiological studies investigating DE in children in developed and developing countries, information is still scarce [6,7]. Some studies have evaluated the occurrence of DE in children with GERD comparing with a control group without GERD, showing that GERD patients had a higher prevalence of DE [8,9]. However in a blinded study with children with and without symptoms of GER the proportion of teeth affected by DE was similar [10]. There is insufficient information in the literature evaluating the associated factors of DE in children with GERD [9]. The identification of the risk factors is increasingly important to establish preventive measures, especially in individuals with GERD. In order to prevent further tooth substance loss, it is important to identify and eliminate the factors responsible for it [6]. As such, the purpose of this study was to identify the factors associated to the occurrence of this alteration in children with GERD through the analysis of dietary habits, oral hygiene, socio-demographic indicators and medical history.

Material and Methods

This study was approved by the Human Research Ethics Committee of the Federal University of Minas Gerais (ETIC 0117.0.203.000-10) and by the University Hospital Board of Ethics Research (039/10). Informed consent forms were obtained from the parents. A convenience sample of 43 children with ages ranging from 2 to 14 years, residents of Belo Horizonte, southeast Brazil, took part in the study. The children were diagnosed for GERD via 24-hour pH monitoring in the University Hospital of the Federal University of Minas Gerais, from May 2006 to January 2011. Clinical examinations were performed by a single examiner (PADO) who was trained and calibrated for the diagnosis of DE. The calibration exercise consisted of two stages that were supervised by a gold standard (SMA). Agreement analysis used the Cohen's kappa coefficient on a tooth-by-tooth basis. The Cohen's kappa values for DE were as follows: intra-examiner agreement = 0.95 and inter-examiner agreement = 0.90.

Pilot Study

A pilot study with the dental examinations and questionnaire administration was carried out with 11 children with GERD ranging from 2 to 16 years of age, who were selected, for convenience, from the University Hospital. The eleven children included in the pilot study did not participate in the main study. The pilot study was performed to test the data collection process and to ascertain the applicability of the questionnaire. The data from this pilot study demonstrated that there was no need to modify the methods proposed for the study.

Dental Examinations

Dental examinations were conducted by a single examiner (PADO), who used appropriate individual cross-infection protective equipment. The children were examined in a private examination room at the University Hospital. All teeth were examined and data were recorded by a trained assistant. The clinical evaluation for the presence of dental erosion was measured using the O'Sullivan index [11].

Socio-demographic characteristics of the sample were collected using a questionnaire that was completed by the parents at the time of the examination. It included information such as age, gender, family income and parental educational attainment. Questions regarding the children's diet and oral habits were based on a previous study [12]. The questionnaire also included specific questions about GERD and other medical conditions.

Data analysis

Descriptive data analysis was performed using the Statistical Package for the Social Sciences (SPSS for Windows, version 17.0, SPSS Inc., Chicago, IL, USA). Chi-squared tests were used to determine the statistical significance ($p < 0.05$) and prevalence rate (PR) with a 95% confidence interval (95% CI) was used to determine the association between the occurrence of dental erosion and socio-demographic characteristics, dietary consumption, oral hygiene habits and medical history. All the independent variables ($p < 0.20$) were entered into multivariate Poisson regression models with robust variance to assess the association between the predictor variables and the outcome. Adjusted PR and confidence interval (95% CI) were also calculated. The level of statistical significance was set at 5%.

Results

A total of 43 children (65.1% boys) with ages ranging from 2 to 14 years (mean age = 6.53, SD 4.04) participated in this study. Dental erosion was observed in 25.6% of the children ($n = 11$). Out of 928 teeth that were examined, 29 (3.1%) displayed DE and the most affected surfaces were the palatal and incisal (62.1%). The severity of erosion was mostly limited to the enamel (82.8%) and dentine (17.2%) with no pulp exposure.

Descriptive statistics of DE association with socio-demographic characteristics and medical history are shown in Table 1, with no statistically significant association. Although children who had

received the GERD diagnostic for more than two years displayed dental erosion over four times higher, this result was not statistically significant. The use of GERD and asthma medication were also not statistically significant in relation to dental erosion in the bivariate analysis (Table 1).

Table 1. Association between dental erosion, socio-demographic characteristics and medical history.

Variable	Dental erosion absent n (%)	Dental erosion present n (%)	Total n (%)	PR	95% CI	P-value*
Gender						
Male	21 (48.8)	7 (16.3)	28 (65.1)	0.94	0.33 – 2.70	1.000
Female	11 (25.6)	4 (9.3)	15 (34.9)			
Age (years)						
2-6	19 (44.1)	6 (14.0)	25 (58.1)	0.86	0.31 – 2.40	1.000
7-14	13 (30.3)	5 (11.6)	18 (41.9)			
Parent's education						
Primary	16 (37.2)	4 (9.3)	20 (46.5)	0.66	0.22 – 1.92	0.501
Secondary	16 (37.2)	7 (16.3)	23 (53.5)			
Family Income						
≤2 times the minimum wage ¹	20 (46.5)	9 (20.9)	29 (67.4)	2.17	0.54 – 8.75	0.291
>2 times the minimum wage	12 (27.9)	2 (4.7)	14 (32.6)			
GERD diagnosis (years)						
>2	17 (39.6)	9 (20.9)	26 (60.5)	2.94	0.72 – 11.99	0.154
≤2	15 (34.8)	2 (4.7)	17 (39.5)			
Current GERD medication						
Yes	7 (16.3)	5 (11.6)	12 (27.9)	2.15	0.80 – 5.75	0.241
No	25 (58.1)	6 (14.0)	31 (72.1)			
Current Asthma Medication						
Yes	13 (30.2)	8 (18.6)	21 (48.8)	2.79	0.85 – 9.13	0.088
No	19 (44.2)	3 (7.0)	22 (51.2)			

*Chi-square test; ¹Minimum wage at the time of examinations=R\$678,00.

There was no statistically significant association between dietary consumption and dental erosion. The use of adult toothpaste was statistically significantly associated with a higher experience of dental erosion in the bivariate analysis (Table 2). In the multivariate Poisson regression model, toothpaste type and asthma medication were both statistically significantly associated with dental erosion (Table 3).

Table 2. Association between dental erosion, dietary consumption and oral hygiene.

Variable	DE absent n (%)	DE present n (%)	Total n. (%)	PR	95% CI	P-value*
Carbonated Drink						
Less than once daily	27 (62.8)	9 (20.9)	36 (83.7)	0.87	0.24 – 3.21	1.000
Once daily or more	5 (11.6)	2 (4.7)	7 (16.3)			
Chewing gum						
Less than once daily	22 (51.1)	10 (23.3)	32 (74.4)	3.44	0.49 – 23.88	0.237
Once daily or more	10 (23.3)	1 (2.3)	11 (25.6)			
Fruit Juice						
Less than once daily	18 (41.9)	8 (18.6)	26 (60.5)	1.74	0.54 – 5.66	0.480
Once daily or more	14 (32.5)	3 (7.0)	17 (39.5)			
Yogurt						
Less than once daily	19 (44.2)	7 (16.3)	26 (60.5)	1.14	0.39 – 3.32	1.000
Once daily or more	13 (30.2)	4 (9.3)	17 (39.5)			
Sweets						
Less than once daily	16 (37.2)	6 (14.0)	22 (51.2)	1.14	0.41 – 3.19	1.000
Once daily or more	16 (37.2)	5 (11.6)	21 (48.8)			
Tooth brushing						
Less than 3X Day	21 (48.8)	6 (14.0)	27 (62.8)	0.71	0.26 – 1.96	0.719

At least 3X Day	11 (25.6)	5 (11.6)	16 (37.2)			
Flossing						
Yes	15 (34.9)	4 (9.3)	19 (44.2)	0.72	0.25 – 2.11	0.728
No	17 (39.5)	7 (16.3)	24 (55.8)			
Toothpaste						
Adult	14 (32.6)	9 (20.9)	23 (53.5)	3.91	0.95 – 16.03	0.039
Children	18 (41.9)	2 (4.6)	20 (46.5)			

*Chi-square test.

Table 3. Multivariate Poisson Regression results associating dental erosion, toothpaste type and asthma medication.

Variables	B	SE	<i>p</i>	PR	95% CI	
					Lower	Upper
Toothpaste						
Adult	1.60	0.67	0.017	4.98	1.34	18.51
Children						
Asthma Medication						
Yes	1.29	0.55	0.018	3.65	1.24	10.70
No						

Discussion

Studies in Australia [9] and Turkey [8] that compared DE in children with GERD with a control group found that children with GERD had more dental erosion experience than did those without GERD. The present study did not aim to associate GERD with DE, because only children with GERD were examined. In fact, it aimed to explain which factors could possibly have influenced the occurrence of DE in those children.

There is no universal index to evaluate dental erosion, therefore it is difficult to compare our findings with others reported in the literature. The O'Sullivan index (2000) made it possible to identify the location, extension and severity of dental erosion, which is important to detect if children with gastroesophageal reflux disease are more likely to be exposed to the intrinsic acid. This result was actually found, because dental erosion was found in the palatal and incisal surfaces of anterior teeth (62.1%).

It has been reported that the gastric juice entering the mouth is an intrinsic cause for DE [13], therefore, children with GERD are at risk of developing DE if they are not properly diagnosed and treated for the condition [1]. The present results showed that 25.6% of the children had DE. All the children examined had received a positive diagnose for GERD by the 24-hour pH monitoring test, and they were referred for further treatment and follow-up. The treatment objectives were to relief the symptoms, promote adequate growth and weight gain and prevent complications associated with GERD [14]. A study suggested that the progression of tooth surface loss would have been even more extensive in GERD patients with uncontrolled acid reflux [15]. In this study, 72.1% of the children were not taking GERD medication at the time of the oral examinations and this was not statistically significantly associated to dental erosion. Prescription medication should be considered as part of the treatment for GERD which includes changes in behavioral and dietary habits [14].

Dental erosion and asthma are both related to GERD [2]. Therefore, a correlation might exist between these two conditions [7]. In the present study, the use of asthma medication was statistically significantly associated with dental erosion according to the multivariate analysis. However, a study in the UK with 12-year-old children did not find any association between asthma and dental erosion. The authors also found that 88% of the drugs prescribed for asthma had a pH above the critical level and were therefore not a threat to the dentition [16]. There was no information regarding the pH of the asthma medication used by the children from the present study. The increased dryness in the mouths of asthmatic patients could be a result of bronchodilators that reduce salivary flow or because of mouth breathing. Because saliva provides neutralizing protection against factors implicated in the pathogenesis of DE, asthmatics are at risk of DE [17]. A study in China found a significant association between dental erosion and respiratory symptoms in GERD patients. The study also suggested that GERD patients with airway symptoms had more liquid or solid-liquid reflux, reaching higher positions in the gastrointestinal tract and possibly the oral cavity [7]. Additional studies in Brazil are required to evaluate whether medication is an extrinsic source of acid for asthmatic children.

In this study, the use of an adult dentifrice by pediatric GERD patients was statistically significantly associated with dental erosion. Different dentifrice formulas may have influenced this result. A possible explanation could be the type and concentration of fluoride as well as its capacity to remineralize the enamel. Most of the dentifrices brands used by children in the present study had similar fluoride concentrations (1100 ppm). An *in situ, ex vivo* study concluded that fluoridated dentifrice is not capable of preventing enamel erosion because highly fluoridated dentifrice (5000 ppmF) was not significantly more protective against enamel erosion than was regular fluoridated dentifrice (1100 ppmF) or placebo [18]. The abrasiveness of dentifrices may be an explanation for the present findings. An *in vitro* study showed that there was more abrasion of acid-softened enamel in dentifrices with higher relative enamel abrasion (REA) using a method that compares abrasiveness values to a reference abrasiveness (ISO). The abrasiveness of the dentifrices could influence the removal of biofilm, which is a protective barrier against DE. Another study found that toothbrush hardness was less relevant than dentifrice abrasiveness in enamel loss [19].

The fluoride-detergent combination in the dentifrices might influence the thickness and viscoelastic properties of the adsorbed salivary-protein films [20]. The acquired pellicle could be a protective barrier, preventing direct contact between acids and the tooth surface [21]. Further investigation is warranted to evaluate such fluoride-detergent combinations in pediatric and adult formulations of dentifrices as well as their possible role in erosion prevention.

As was observed in the present study, socio-demographic characteristics were not related to dental erosion according to other Brazilian researches [22,23]. However, a higher prevalence of dental erosion was found in children from families with higher income [24]. In China, it was found that children whose mothers had a lower level of education had more dental erosion [7], although another study noted that the prevalence was higher in children of more educated parents [25]. The

inconsistent influence of parental education and consequent family income may be explained by different dietary habits and lifestyles as well as differences in the knowledge of oral hygiene and healthy habits. In this study, there was no statistically significant association between dietary consumption and dental erosion. The fact that this was a cross-sectional design may have contributed to this result and it is possibly a limitation for our study. Children with GERD in this study might have changed dietary and behavioral habits to improve their quality of life. They avoided acid foods and drinks because such items tended to aggravate symptoms. Patients should be informed of factors that may precipitate acid reflux. They need to be advised of lifestyle and behavior modifications as part of overall treatment and management of GERD and DE [26].

There is a positive correlation between GERD and DE and its presence in the primary dentition should be a key for the dentist to refer the child to the gastroenterologist [27]. The multidisciplinary approach facilitates the transmission of knowledge and widens the exchange of information between the different areas involved. However, there is still insufficient knowledge about DE even amongst dental school students and faculty members [28]. Therefore, there is a great need for better understanding the associated factors of DE in order to prevent or treat this condition, and also improve the patients' quality of life.

Conclusion

This study showed that 25.6% of children with GERD were affected by dental erosion. The use of asthma medication and adult toothpaste was statistically significantly associated with dental erosion in children with GERD.

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