Association Between Socioeconomic Factors and Dental Erosion in Brazilian Schoolchildren

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Abstract

Objective: *The aim of this study was to evaluate if a higher socioeconomic status is a potential risk factor for dental erosion in 6- to 12-year-old Brazilian schoolchildren.* ***Methods:*** *A sample of 983 children was drawn from 36 schools. A questionnaire was applied to determine socioeconomic background. Clinical exams for dental erosion were carried out by one trained and calibrated examiner considering location, severity, and surface area affected. Chi-square tests and multivariate analysis were carried out.* ***Results:*** *Dental erosion was detected in 196 children (19.9 percent). From this total, 61.8 percent of the lesions were found in the primary dentition and 38.2 percent in the permanent dentition. The palatal surface was the most affected. Higher prevalence was observed in males (P = 0.005). Dental erosion was more prevalent in private school children than in public school children (P = 0.029). Also, dental erosion was prevalent in children from families with higher income (21.3 percent) than in children from low-income families (13.5 percent) without significant difference (P > 0.05). A higher prevalence of erosion was observed in those children whose parents had a high education level (22.7 percent, P = 0.05).* ***Conclusions:*** *The data suggest a high prevalence of dental erosion across this age span. Dental erosion seems to occur most often in primary dentition of boys who attended private schools and whose mothers have a high educational status.*

Key Words: tooth erosion, epidemiology, risk factors, primary teeth, permanent teeth

Introduction

The prevalence of tooth surface loss (abrasion, attrition, and erosion) has received increased interest in the dental literature in recent years (1). In this context, it must be pointed out that dental erosion may be a major cause of tooth wear (2).

Dental erosion has been defined as a progressive loss of hard dental tissue by a chemical process, which does not involve bacteria (3,4). This superficial tooth mineral loss can take place when the oral environment reaches a pH below 4.5 (5). The etiology of erosion is multifactorial, and it may be idiopathic or caused by a known acid source. A large number of acid sources have been identified including the consumption of acid foods (6), exposure to acidic contaminants at work, environment (4), diet, medication (7), lifestyle, and gastroesophageal refluxing (8).

It has been observed that the prevalence of erosion varies from 5.7 to 70 percent in primary teeth (1,9) and from 11.6 to 60 percent in the permanent dentition (1,10). However, most epidemiologic studies addressing dental erosion have been conducted in developed countries (1). As a result, dental erosion is thought to be linked with high socioeconomic background, but inconsistent findings on the relationship between erosion and social factors have been reported (11) and this was not evaluated in developing countries. In fact, the few Brazilian epidemiologic studies performed so far were restricted to the more favorable areas of the Southeastern part of the country (3,12). Thus, no data are available focusing on dental erosion in communities where dietary habits are less influenced by processed food or in the general population with unfavorable socioeconomic strata. Therefore, the aim of this study was to evaluate the socioeconomic status as a potential risk factor for dental erosion in 6- to 12-year-old Brazilian schoolchildren.

Methods

Subjects. This study was conducted from the year 2006 to 2007 among 983 children from public and private schools in João Pessoa, capital of Paraíba, a state in the northeastern region of Brazil. João Pessoa has a population of 674,762 inhabitants. The city does not have a water fluoridation program and it presents one of the lowest values of Human Development Index among the major cities of Brazil. In the Northeastern region of Brazil, about 39 percent of the families survive on half of the legal minimum wage (13,14).

The children in this study were drawn from a cluster random sample comprising of 6- to 12-year-old schoolchildren of both genders. In total, there were 45,471 children attending 93 public and 169 private schools in João Pessoa. A multistage sampling technique was used to select the schools. A list of all the schools was obtained from the local education department. The schools

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were then stratified according to geographic districts of the city. A total of 40 schools were randomly selected, 20 private and 20 public schools, as a representative of the social and ethnic mix, following the guidelines set by the Brazilian National Survey for oral health conditions (15).

The calculation of the sample was based on a previous pilot study conducted to estimate the prevalence of dental erosion in five schools ($n = 100$). The estimated prevalence observed was 10.5 percent. Thus, the sample size was calculated assuming an expected prevalence of 10.5 percent and a z-value of 1.96. A minimum sample size of 945 children was determined. Furthermore, the sample size was increased by 20 percent to allow for additional losses. A total of 1,134 children were recruited, 569 from public schools and 565 from private schools. Using classroom lists of the sampled schools, a systematic random sampling procedure was carried out to select the children. Four private schools did not agree to participate in the research, some children were absent on the days of the examination, and others had changed schools; thus, 151 questionnaires were not properly completed. As a result, the final analysis was done using 983 children. Approval for the study was obtained from the local government and the heads of the public and private schools. The children's parents gave their informed consent to participate in this study and ethical approval was given by the Federal University of Paraíba Research Ethics Committee (743/06).

Socioeconomic Background. Before the clinical examination, the children's general information and the socioeconomic status data were obtained by the parents completing a questionnaire. The socioeconomic status risks included: type of school (public or private), parental educational status, and family income. For the purpose of this study, parental educational status was classified into "no education" (no school attendance at all), "low education" (secondary or below), or "high education" (postsecondary). Family income was classified as: "less than one legal minimum wage," "from one to three times the legal minimum wages," and "more than four times legal minimum wages." The legal minimum wage during the study was about US$200 per month.

Data Collection. A total of 983 selected children with informed consent from their parents were clinically examined in their schools by the same examiner. Children were examined under natural light in a sitting position using individually wrapped and sterilized mouth mirrors and gloves. Measurement of erosion was confined to primary and permanent maxillary incisors, according to O'Sullivan index (8) that was adapted and validated for maxillary incisors by Peres *et al*. (3), and are listed in Figure 1. All the tooth surfaces were dried with cotton rolls. Partially erupted primary and permanent teeth were not recorded.

Calibration and Reproducibility. Training and calibration of the examiner in the use of this index were carried out by an experienced

Figure 1
O'Sullivan (2000) (8) adapted and validated by Peres *et al.* (2005) (3)

Site of erosion on each tooth

Code A	Labial only
Code B	Palatal only
Code C	Incisal only
Code D	Labial and incisal
Code E	Palatal and incisal
Code F	Multi-surface

Grade of severity (worst score for any individual tooth recorded)

Code 0	Normal enamel
Code 1	Matte appearance of the enamel surface with no loss of contour
Code 2	Loss of enamel only
Code 3	Loss of enamel with exposure of dentin (ADJ visible)
Code 4	Loss of enamel and dentin beyond ADJ
Code 5	Loss of enamel and dentine with exposure of pulp
Code 9	Unable to assess (e.g. tooth crowned or large restoration)

Area of surface affected by erosion

Code -	Less than half of the surface affected
Code +	More than half of the surface affected

epidemiologist before the survey. Consistency of the diagnosis of the examiner during the pilot study and the fieldwork was checked by intra-examiner variability tests following the same examination procedures. Ten percent of the children ($n = 98$) examined were randomly selected and reexamined on a separate occasion. The examiner had no access to the previous records. Kappa scores were calculated by the three criteria of the index: surfaces affected by erosion, severity, and affected area.

In the pilot study, the Cohen's kappa values for dental erosion, severity, and area affected were 1.00, 0.89, and 0.83, respectively. In the fieldwork, the values, using the same criteria, were 0.92, 0.91, and 1.00, respectively.

Statistical Analysis. The data were organized and analyzed using the SPSS 13.0 statistical software package (SPSS Inc., Chicago, IL, USA). The relationship between dental erosion and the independent variables (gender, age, family income, mother's educational status, and type of school) were evaluated using chi-square tests. Statistical significance was set at the 5 percent level. A 95 percent confidence interval (CI) was considered for comparisons of different results within subgroups.

A logistic regression analysis model was built to assess the influence of the independent variables on the presence of dental erosion. The logistic regression model took all the independent variables into account (gender, age, type of dentition, type of school, family income, and mother's educational status). For the analysis, all the erosion types were combined in the category "presence." Enter mode was used to reduce the number of variables in the model with $P < 0.05$.

Results

Among the children examined ($n = 983$), 474 (48.2 percent) were boys and 509 (51.8 percent) were girls. Of these, 196 (19.9 percent) had at least one tooth showing signs of erosion. Dental erosion was higher in males (57.1 percent) than in females (42.9 percent) ($\chi^2 = 7.80$, $df = 1$, $P < 0.05$).

From this total of 196 children, a higher prevalence of erosion was found in primary dentition ($n = 121$, 61.8 percent) than in permanent dentition ($n = 75$, 38.2 percent), ($\chi^2 = 233.51$, $df = 1$, $P < 0.05$). As a result, the frequency of dental erosion by age group in all examined children showed that younger children (6 and 7 year olds) presented more erosion lesions ($n = 69$, 35.2 percent and $n = 36$, 18.3 percent, respectively) than older children.

Of the total surfaces affected ($n = 199$ teeth) in the primary dentition, 79 primary teeth (39.7 percent) were identified in palatal and incisal surfaces, 44 (22.1 percent) on just palatal surface, four (2.0 percent) on just labial, 39 (19.6 percent) on just incisal, three (1.5 percent) on labial and incisal, and 30 (15.1 percent) on multi-surface. In permanent teeth ($n = 103$ teeth), lesions were not observed on multi-surfaces, 21 (20.3 percent) on just labial, 31 (30.1 percent) on just incisal, one (1.0 percent) on labial and incisal, one (1.0 percent) on palatal and incisal surfaces, and dental erosion was more common on palatal surface 49 (47.6 percent).

The erosive lesions that were found in primary teeth, were divided into four grades of severity: matte appearance of the enamel surface with no loss of contour, loss of enamel only, loss of enamel with exposure of dentin [visible at dentinoenamel junction (ADJ)], and loss of enamel and dentin beyond the dentinoenamel junction. In contrast to primary teeth, only two grades of severity were found in permanent teeth (Figure 2).

The majority (62.2 percent) of the teeth affected by dental erosion had less than half of the surface affected and pulp exposure was not observed in either the primary or permanent dentition.

The prevalence of dental erosion in relation to socioeconomic status is listed in Table 1. Considering the highest and lowest levels of education, a higher prevalence of erosion was seen in those children whose parents were from the high-education group (22.7 percent). The lowest prevalence was seen in those children whose parents were from the low-education group (12.1 percent). The erosion prevalence of this high-education group was about two times more than that from the low-education group ($\chi^2 = 7.53$, $df = 3$, $P = 0.05$).

One multivariate logistic regression model previously described was evaluated. All the variables were included in the model, but only the type of dentition was a risk factor for dental erosion ($P < 0.0001$, 95 percent CI = 0.189-0.389; Table 2).

Discussion

There is evidence that the prevalence of dental erosion is gradually increasing (16). However, because of a difficult diagnosis, epidemiologic studies of dental erosion have shown a great diversity of methodological procedures, resulting in variations in the scoring systems that need to be considered when comparing with the previous studies.

This study focused on dental erosion in the age groups of 6- to 12-year-olds for two main reasons. First of all, 6-year-olds are at a susceptible period to erosive challenge in the primary dentition. Thus, it is possible to study and compare dental erosion prevalence in primary, mixed, and permanent dentitions. Secondly, many epidemiologic studies on dental erosion have already included children of this age. The inclusion of maxillary incisors is appropriate because these teeth have been exposed in the mouth for a considerable number of years when compared with any other type of teeth. Therefore, it is likely that they will have a higher exposition to intrinsic and extrinsic etiological factors that may cause dental erosion.

O'Sullivan index that was adapted and validated by Peres *et al.* (3) was used because it is simple, easy to use, and sensitive to small changes. This index also has the advantage of

evaluating different criteria: site of erosion, severity, and affected tooth surface area. Others indices were not used because some types are not specific to erosion, such as the Tooth Wear Index. In addition, difficulties for comparison between studies when using UK Children's Dental Health Survey have been reported (17).

The prevalence of erosive tooth wear in the present population study amounted to 19.9 percent and is therefore considerably lower when compared with other similar studies with rates of 31 to 59 percent (10,17-19). However, a similar value was found in Southern Brazil (3) and lower prevalence was found in China (9). Some studies do not report gender differences in erosion prevalence (3,16,18,19), although a higher prevalence of dental erosion among males was also found in other studies

Figure 2
Distribution of erosive lesions in primary and permanent teeth expressed as percentage of lesions grade 1 (white columns), grade 2 (light gray), grade 3 (dark gray columns), and grade 4 (black columns) in all examined children with dental erosion

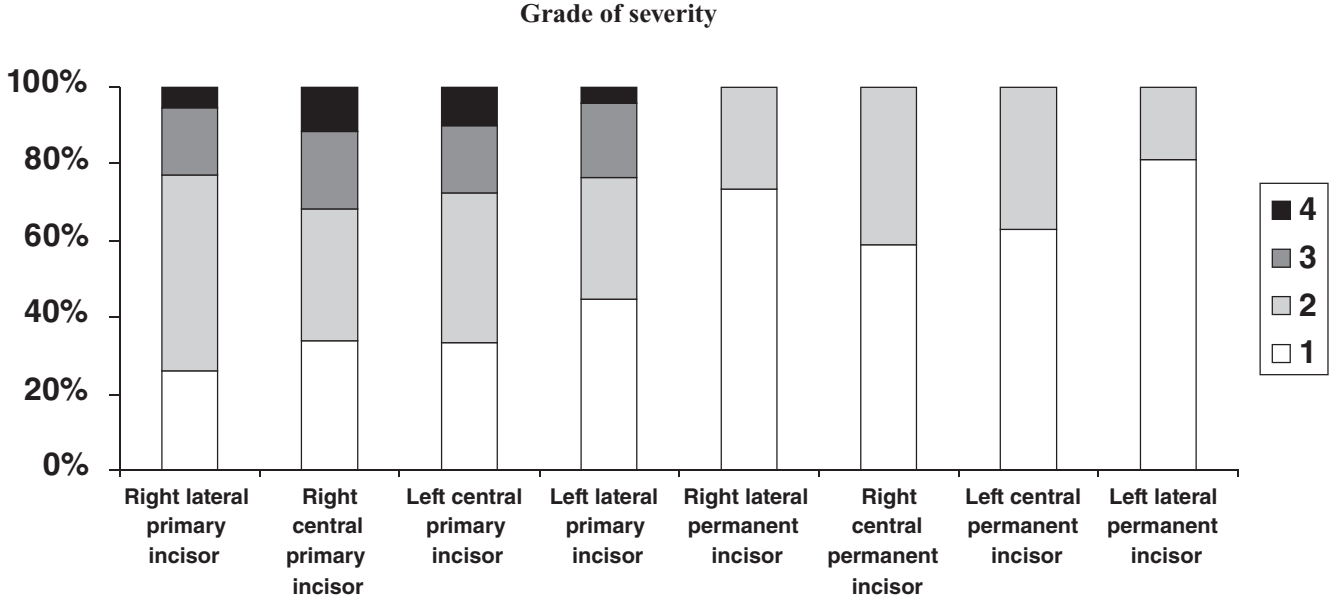

Table 1
Prevalence of Dental Erosion in Relation to Socioeconomic Status [Type of School (Public or Private), Parental Educational Status, and Family Income]

	No erosion		With erosion		Total	
Variable	*n*	(%)	*n*	(%)	*N*	*P*-value
Family income*						
<than one legal minimum wage	174	(86.5)	27	(13.5)	201 (100.0)	0.102
One to three times the legal minimum wage	288	(82.0)	63	(18.0)	351 (100.0)	
>3 times the legal minimum wage	181	(78.7)	49	(21.3)	230 (100.0)	
Parental educational status†						
No education	74	(84.1)	14	(15.9)	88 (100.0)	0.05
Low	131	(87.9)	18	(12.1)	149 (100.0)	
Medium	276	(80.4)	67	(19.6)	343 (100.0)	
High	194	(77.3)	57	(22.7)	251 (100.0)	
Type of school‡						
Public	410	(82.8)	85	(17.2)	495 (100.0)	0.029
Private	377	(77.2)	111	(22.8)	488 (100.0)	

* $\chi^2 = 4{,}560$, $df = 2$, $n = 782$ (responded questionnaires).
† $\chi^2 = 7.53$, $df = 3$, $n = 831$ (responded questionnaires).
‡ $\chi^2 = 4.78$, $df = 1$, $n = 983$.

Table 2
Multivariate Logistic Regression Model

Variable	B	SE	Wald	*P*-value	Exp(B)	CI	
						Lower	Upper
Gender	−0.183	0.204	0.808	0.369	0.833	0.559	1.241
Age	0.030	0.091	0.112	0.738	1.031	0.863	1.232
Type of school	0,124	0.259	0.228	0.633	1.132	0.681	1.881
Type of dentition	−1.305	0.185	49.610	0.000	0.271	0.189	0.389
Family income	−0.094	0.111	0.724	0.395	0.910	0.733	1.130
Parental educational status	0.167	0.126	1.756	0.185	1.182	0.923	1.513
Constant	1.365	0.751	3.302	0.069	3.914		

CI, confidence interval; SE, standard error.

(10,20,21). The differences in the prevalence data between these studies may be partly explained by the differences in diagnostic criteria and indices and varying socioeconomic, cultural, and geographical factors, which could influence the outcome of the prevalence data (22).

In the present study, the primary dentition was more affected by dental erosion than the permanent dentition. Likewise, other studies reported similar findings for primary (1,17) and permanent teeth (16,18). Primary teeth have a higher risk for erosion lesions because their enamel and dentin layers are thinner and less mineralized than permanent teeth (6). Except for one study (10), most reports show higher prevalence of dental erosion in primary dentition.

The palatal surface predilection for dental erosion in permanent teeth was in agreement with previous studies (10,16), and this may be explained by the poor saliva clearance of the upper anterior teeth. However, a high prevalence of erosion in buccal surfaces has been observed in other studies (3,17,23). Concerning the high prevalence of erosion on the palatal and incisal surfaces in the primary dentition, the result of this study was in agreement with a previous report (22).

Analyzing the severity of erosion, the present results showed worst scores in primary teeth when compared with permanent ones. The most prevalent severity grade was the matte appearance of dental enamel surface with no loss of contour in permanent dentition. No pulp exposure was observed as reported in the majority of the studies (3,10,17,20).

Evaluating the socioeconomic background risks, previous studies have shown contradictory results. Erosion seems to be more prevalent in high socioeconomic groups of children in Birmingham, UK (2). In contrast, a high prevalence of erosion in underprivileged groups in different regions of UK was also observed (21,23). Overall, in the present study, no difference between socioeconomic groups was found, which supports other findings (10,16). It is important to emphasize that the child's school was regarded as an indication of social class, with those attending private schools, being from families of higher socioeconomic status. This approach is valid for Brazilian surveys and it was already applied (3). In Brazil, significant differences in the prevalence of dental erosion between children from public and private schools were observed (3). Nevertheless, considering the differences in oral health hygiene practices, fluoride exposure, socioeconomic factors, and dietary habits between these two Brazilian groups, different risk factors may be operating. One must bear in mind that in Brazilian public schools, the availability of processed food and drinks is lower than in private ones, but in both schools, the parents lack appropriate information about preventive measures for oral health (24).

Aspects of lifestyle may influence the presence of dental erosion (10). By analyzing the parental educational status, it was possible to observe that dental erosion prevalence was higher in children whose mothers are with high educational status. This might be an important factor that influences the lifestyle of the families (9). Probably, a higher parental education and parents spending more time away from home might be influencing the increased amount and frequency of fast food and carbonated drink consumption of children in the last years.

It is only recent that tooth erosion has been recognized as presenting a dental health problem in children. In this study, after multivariate analysis with logistic regression, only the type of dentition was selected to explain the occurrence of dental erosion in the studied population. Some authors have observed that primary enamel was softer than enamel of permanent teeth and, subsequently, more liable to erosion (6).

In conclusion, a high prevalence of dental erosion was observed in this group of Brazilian children. Dental erosion seems to occur most often in primary dentition of boys who attend private schools and whose mothers had a high educational status.

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