Dental erosion in 12-year-old schoolchildren: a cross-sectional study in Southern Brazil

K. G. PERES\textsuperscript{1,2,4}, M. F. ARMÊNIO\textsuperscript{2}, M. A. PERES\textsuperscript{3,4}, J. TRAEBERT\textsuperscript{1,2} & J. T. DE LACERDA\textsuperscript{1}

\textsuperscript{1}Universidade do Sul de Santa Catarina (UNISUL), Tubarão, \textsuperscript{2}Grupo de Pesquisa em Saúde Coletiva-Universidade do Oeste de Santa Catarina (UNOESC), Joaçaba, \textsuperscript{3}Departamento de Saúde Pública, Universidade Federal de Santa Catarina (UFSC), Florianópolis and \textsuperscript{4}Grupo de Estudos em Odontologia em Saúde Coletiva (GEOSC), UFSC, Florianópolis, Santa Catarina, Brazil

Summary. Objective. The aim of this study was to assess the prevalence and severity of dental erosion among 12-year-old schoolchildren in Joaçaba, southern Brazil, and to compare prevalence between boys and girls, and between public and private school students.

Methods. A cross-sectional study was carried out involving all of the municipality’s 499, 12-year-old schoolchildren. The dental erosion index proposed by O’Sullivan was used for the four maxillary incisors. Data analysis included descriptive statistics, location, distribution, and extension of affected area and severity of dental erosion.

Results. The prevalence of dental erosion was 13.0% (95% confidence interval = 9.0–17.0). There was no statistically significant difference in prevalence between boys and girls, but prevalence was higher in private schools (21.1%) than in public schools (9.7%) (P < 0.001). Labial surfaces were less often affected than palatal surfaces. Enamel loss was the most prevalent type of dental erosion (4.86 of 100 incisors). Sixty-three per cent of affected teeth showed more than a half of their surface affected.

Conclusion. The prevalence of dental erosion in 12-year-old schoolchildren living in a small city in southern Brazil appears to be lower than that seen in most of epidemiological studies carried out in different parts of the world. Further longitudinal studies should be conducted in Brazil in order to measure the incidence of dental erosion and its impact on children’s quality of life.

Introduction

Over recent decades, with the decline in both the prevalence and severity of dental caries in children from most developed countries [1], as well as in Brazil [2,3], has come an increasing interest in other dental disorders including dental erosion. Renewed interest in the study of tooth wear, and especially of erosion, began in the 1980s [4].

Dental erosion is defined as the acid dissolution of the tooth surface by chemical attack not involving bacteria [5]. The aetiological factors of dental erosion in children and adolescents include: acidic beverages, such as citric fruit juices, soft drinks and carbonated beverages; vomiting and gastroesophageal reflux; and frequent swimming in heavily chlorinated water. Acids present in the work environment, bulimia, heavy alcohol consumption and spicy food consumption have also been mentioned as major risk factors among adults [6].

Much research in this area has been focused on clinical aspects through case reports, or \textit{in vivo}
intraoral pH measurements. There have also been studies involving superficial microhardness determinations of enamel and dentin, and in vitro and animal investigations [7,8].

Most epidemiological studies addressing dental erosion have been conducted in developed countries, such as the UK [4,9–11]. In contrast, Medline and Brazilian Library of Dentistry (BBO) searches have failed to show data on dental erosion in population-based studies in Brazil. Consequently, the prevalence and severity of dental erosion in Brazil are currently unknown.

The aim of this study was to assess the prevalence and severity of dental erosion in 12-year-old schoolchildren from Joaçaba, Southern Brazil, and in addition, to compare the prevalence of dental erosion in boys and girls, and between schoolchildren enrolled in public and private schools.

**Subjects and methods**

A cross-sectional study was carried out in Joaçaba in the western region of the state of Santa Catarina, Southern Brazil. All 12-year-old schoolchildren (n = 499) of both sexes attending public and private primary schools in the city in 2001 were invited to participate in the survey. A total of 391 children were examined in this cross-sectional survey.

The study was formally supported by the Brazilian Dental Association – Santa Catarina (Associação Brasileira de Odontologia – Santa Catarina) and by Joaçaba Municipal Health Authorities. A written consent was required from each parent or guardian. A letter was sent to the parents stating the objectives and importance of the study, asking for their participation, and assuring them that children who opted not to participate in the study would not be discriminated against in any way. Local authorities such as health and education councils were also contacted, and provided necessary information and authorization.

One examiner (M.F.A.) carried out clinical examinations supported by a scribe. Before commencing, M.F.A. was trained by an experienced dental epidemiologist (K.G.P.) who was regarded as the gold standard. A range of different levels of dental erosion was used in the calibration exercise, which was based on diagnosis of photographic images. Reliability was assessed through the Kappa test.

The dental erosion index proposed by O’Sullivan [12] was adopted and was adjusted for use in the four upper incisors (Fig. 1). The partial record using groups of index teeth was used to make the index more applicable for larger-scale population surveys, where there is the need to measure several different disease processes, or a very large sample [13]. Children were clinically examined at their schools under standard artificial illumination using plane mouth mirrors and sterilized gauze to remove gross debris. The four upper incisors were examined. Each examination for erosion lasted 30 s on average. Children with fractured teeth, hypoplasia, extensive restorations or who were wearing orthodontics appliances were excluded.

<table>
<thead>
<tr>
<th>Site of erosion on each tooth</th>
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<tr>
<td>Code A</td>
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<td>Code C</td>
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<th>Grade of severity (worst score for any individual tooth recorded)</th>
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<td>Code 0</td>
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<th>Area of surface affected by erosion</th>
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The sociodemographic data collected included sex and type of school. ‘Type of school’ refers to the differentiation of students enrolled in public and private schools. Since public schools do not collect tuition fees, it was assumed, as in previous studies, that children attending private schools in the Brazilian context would be of higher socioeconomic status than those enrolled in public schools [14].

Intra-examiner reliability during field work was checked with duplicate examinations of every tenth subject. The Kappa statistic was calculated on a tooth-by-tooth basis. The Epi info 6·04 computer program was used, and data analysis included descriptive statistics, including distribution of erosion, and its extent and severity. Differences in the prevalence of dental erosion according to gender and type of school were tested in terms of frequencies using the chi-square test. The level of significance was set at $P < 0·05$.

**Results**

Of the 499, 12-year-olds in the municipality, a total of 391 children were examined. Thus, the response rate obtained was 78·3%. The main reasons for nonresponse were absence on the day of the exam and lack of parental consent. Differences between school types in these losses were not statistically significant ($P = 0·20$). Of the 391 children included, 203 (51·9%) were boys and 188 (48·1%) were girls; 277 (70·8%) were from public schools and 114 (29·2%) from private schools.

Kappa values calculated for intraexaminer variability were all higher than 0·78.

The prevalence of any dental erosion was 13·0% [95% confidence interval (95% CI) = 9·0–17·0], with no significant difference between sexes (Table 1). Table 1 also shows that the prevalence was significantly different between school types ($P = 0·004$), i.e. it was higher in private schools (21·1%) than in public schools (9·7%).

Of the total surfaces affected ($n = 150$), 31·3% and 24·7% were identified in labial and on palatal surfaces, respectively (Table 2). Concerning the severity of dental erosion, enamel loss without the loss of tooth surface characteristics was observed in most cases (4·86 of 100 incisors), followed by the enamel loss with loss of tooth contour (4·41 of 100 incisors) (Table 3). In 62·6% of the affected teeth, more than half of the tooth’s surface was affected (Table 4).

**Discussion**

Both the high response rate and the high intraexaminer agreement observed suggest that the
internal validity of this study was good. In addition, since the attendance rate among schoolchildren in Joaçaba is very high, reaching more than 90% [15], it is reasonable to generalize the results for 12-year-old children as a whole in this municipality. The use of upper incisors when investigating dental erosion in 12-year-old children is appropriate since, at this age, these teeth have been exposed in the mouth for a considerable length of time when compared to other teeth. Thus, incisors are more exposed to possible intrinsic and extrinsic aetiological factors which may cause dental erosion. Other studies have included molars since these teeth have also been shown to be susceptible to erosion. However, confining examination to incisors was thought to make the index easier to use in large studies.

It is difficult to distinguish the three main types of tooth wear, i.e. erosion, attrition and abrasion, and it is likely that all three processes may have been included in some of the cases seen in this study. The use of a smaller number of index teeth may make it easier to achieve good validity. According to Steele and Walls [13], it is difficult to train examiners to measure any one of these conditions to a high level of agreement, let alone all of them. Moreover, the full assessment of all of these conditions is very time-consuming.

A 13% prevalence of dental erosion was found among 12-year-old schoolchildren (95% CI = 9.0%–17.0%). This prevalence is similar to the results of a study conducted by Ganss et al. [16], who found that 11.6% of children with permanent teeth had at least one tooth with some level of erosion. The above authors had used pre-orthodontic study models from 1000 individuals between 1977 and 1999 in Germany. On the other hand, the prevalence found in this study was lower than the majority of findings reported by several other authors in different countries. In the UK Children’s Dental Health Survey of 1993, 32% of 14-year-old children showed some degree of erosion [10]. Milosevic et al. [17], reported that 30% of 14-year-old children exhibited exposed dentin because of erosion in Liverpool, UK. Pronounced dental erosion was observed in 26% of a sample of 12–14-year-old in Riyadh, Saudi Arabia [18]. A very high prevalence of dental erosion was also observed in the USA (41%) among children aged 11–13 years [19]. Another study, conducted in Birmingham, UK, found a 48% prevalence among 14-year-old schoolchildren [20]. A higher prevalence than that of this study was also reported for a random sample of 12-year-old schoolchildren living in Leicestershire and Rutland, UK, where 56.3% of subjects had some level of dental erosion [21].

The differences observed between the results of this study and those of other investigations may be explained by several factors. First, the different criteria used in the various studies could be at least partly the reason for this discrepancy. The Tooth Wear Index (TWI) [22] is the most extensively adopted index to measure dental erosion, but it can overestimate the prevalence of this condition because it is not specific for dental erosion, and consequently, measures different types of tooth wear. Secondly, it is difficult to compare the results of prevalence studies when different teeth are included in the measurement method. Standardization of the indices and the teeth examined would facilitate such comparisons. Finally, the permanent dentition analysed in different studies shows erosion at ages ranging from 12 to 14 years, which may also influence the results through differences in time of exposure to risk factors.

The predominance of erosion on the labial surface seen in this study is in agreement with data reported by Williams et al. [11] and also by Al-Majed et al. [18].

In this study, the child’s school was regarded as a proxy for social class, with those attending private schools being from families of higher socioeconomic status.

When the influence of socioeconomic status on the prevalence of dental erosion is reviewed, previous studies have shown contradictory results. Millward et al. [23] found a higher prevalence of erosion among children of higher socioeconomic status than among underprivileged children in Birmingham, UK, although the children included were of younger age than those in the current study. Williams et al. [11] reported palatal erosion as more prevalent in more affluent areas compared to deprived areas in two inner-city boroughs of London, UK. In contrast, Al-Dlaigan et al. [20] reported a significantly higher prevalence of erosion in teenagers of the lowest socioeconomic group in Birmingham, UK, and Milosevic et al. [17] also found a slight positive association between tooth wear and the level of social deprivation (according to the electoral ward where the school was located) in Liverpool, UK. Erosion experience was also found to be associated with social deprivation in 12-year-old schoolchildren, in Leicestershire, UK [21].

One hypothesis that could explain the findings of this study is related to dietary habits, especially the
consumption of acidic beverages, such as soft drinks, carbonated beverages and yoghurt. These risk factors are more prevalent among higher-income social groups, such as children enrolled in private schools, in both international [24] and Brazilian food consumption surveys [25,26], but this pattern may not be true in all countries. For example, it may be that the consumption of erosive drinks in the UK is greater among those of lower socioeconomic status.

In this study, there was no difference in the prevalence of dental erosion between males and females, which is in agreement with a study carried out by Deery et al. [19] in the UK and the USA. On the other hand, Milosevic et al. [17] found a significantly higher prevalence of exposed dentin in males than in females, mainly affecting the incisal edge. The same result was obtained by Al Dlaigan et al. [20] in Birmingham, UK, where more males had buccal/labial and lingual/palatal tooth surface erosion than females, and also by Dugmore et al. [21] in Leicestershire, UK. The absence of significant differences in the prevalence of dental erosion between boys and girls in this study may perhaps be explained by a similar patterns of exposure to risk factors in this population.

The majority of teeth affected by dental erosion had less than half of the surface affected. One hypothesis is that these individuals may have been exposed to dental erosion risk factors at low levels, or for a relatively short time. Longitudinal studies should provide evidence to correctly explain this finding.

It may be concluded that the prevalence of dental erosion in 12-year-old schoolchildren living in a small city in Southern Brazil is lower than has been reported in most epidemiological studies carried out in different countries. The current results suggest the need for further research on the prevalence and incidence and progression of dental erosion in Brazil.

Therefore the authors recommend further longitudinal epidemiological studies in order to measure the incidence of dental erosion as well as to assess its impact, if any, on children’s quality of life.

Résumé. Objectif. L’objectif de cette étude a été d’évaluer la prévalence et la sévérité de l’érosion dentaire chez les enfants de 12 ans, scolarisés, de Joaçaba, Sud du Brésil, et de comparer la prévalence entre garçons et filles et entre enfants des écoles publiques et privées.

Méthodes. Une étude transversale a été menée chez 499 enfants de 12 ans scolarisés. L’indice d’érosion dentaire proposé par O’Sullivan a été utilisé pour les 4 incisives maxillaires. L’analyse des données a inclus des statistiques descriptives, la distribution des sites, l’étendue des zones affectées et la sévérité de l’érosion dentaire.

Résultats. La prévalence de l’érosion dentaire était de 13,0% [95% IC 9,0%–17,0%]. Il n’y avait pas de différence statistiquement significative entre garçons et filles, mais la prévalence était plus importante dans les écoles privées (21,1%) que publiques (9,7%) (p < 0,001). Les surfaces vestibulaires étaient moins souvent atteintes que celles palatines. La perte d’émail était le type le plus fréquent (4,86/100 incisives). Soixante-trois pour cent des dents atteintes avaient plus de la moitié de leur surface affectée.

Conclusion. La prévalence de l’érosion dentaire chez les enfants de 12 ans scolarisés d’une petite ville du Sud Brésil semble plus faible que celle rencontrée dans la plupart des études épidémiologiques menées dans différentes parties du monde. Des études longitudinales devraient être menées au Brésil afin de mesurer l’incidence de l’érosion dentaire et son impact sur la qualité de vie des enfants.


**Resultados.** La prevalencia de la erosión dental fue del 13,0% (95% CI 9,0%–17,0%). No hubo diferencias estadísticamente significativas en la prevalencia entre niños y niñas, pero la prevalencia fue más alta en escuelas privadas (21,1%) que en escuelas públicas (9,7%) (p < 0,001). Las superficies labiales estaban afectadas con menos frecuencia que las superficies palatinas. La pérdida de esmalte fue el tipo más prevalente de erosión dental (4,86/111 incisivos). El 63% de los dientes afectados mostró más de la mitad de una superficie afectada.

**Conclusión.** La prevalencia de erosión dental en niños escolares de 12 años viven en una ciudad pequeña en el Sur de Brasil parece ser menor que lo visto en la mayoría de estudios epidemiológicos realizados en diferentes partes del mundo. Deberían hacerse en Brasil más estudios longitudinales para medir la incidencia de la erosión dental y su impacto en la calidad de vida de los niños.

**References**


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