Dental Erosion Risk Factors in 6 to 12 Year Old children in Mexico City

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Objective: *To assess the prevalence and dental erosion risk factors in Mexican schoolchildren.* ***Study design:*** *A transversal and analytical study was conducted on 411 children aged 6 to 12 years old in a public primary school of Mexico City. The children's parents answered a standardized questionnaire about their risk factors, and the Smith and Knight index was applied to assess their dental erosion degree.* ***Results:*** *The prevalence of dental erosion was 62%. The odds ratio and X^2 tests revealed that probiotic beverage consumption (OR 1.658; CI 95%: 1.106–2.485; p = 0.014), sports beverages (OR: 2.807; CI 95%: 1.129-6.983; p = 0.021), natural juices (OR: 3.344; CI 95%: 1.556-7.184; p = 0.003), fruits and snacks with hot peppers and lemon (OR: 1.594; CI 95%: 1.066-2.382; p = 0.023), and syrups (OR: 1.869; CI 95%: 1.060-3.296; p = 0.029) were all risk factors for dental erosion.* ***Conclusions:*** *This study indicated that a high existence of dental erosion, which mainly affects the primary molars, is related to the frequent consumption of beverages and foods with acidic pH levels.*

Keywords*: dental erosion, prevalence, primary teeth.*

INTRODUCTION

Dental erosion is an oral health problem that comprises an irreversible and progressive loss of dental structure due to acidic chemical activity without bacterial affectation. [1] Over the last few years, there has been an increase in the prevalence of this condition among children and adolescents. [2] Dental erosion (DE) begins with demineralization, which is followed by the dissolution and subsequent loss of the tooth layers, leaving a fragile and sensitive dental structure. Microscopically, the teeth begin to look whitish and opaque; the resulting changes vary from the exposition of the enamel prisms to tissue loss. [3] Clinically, DE has an opaque and smooth appearance, without periquimatas. In particular, the gingival margin remains intact. In the vestibular and palatine faces of the anterior teeth, DE is mainly characterized by an increase in incisal translucency via a yellowish color that reflects dentine exposure due to enamel loss or the translucency of pulp tissue. In the occlusal aspect of the posterior teeth, the concavity on the rounded cusps (cuppings) of the tooth enamel becomes deeper, and therefore, the occlusal morphology disappears. If restorations are present, they look different with respect to the surrounding dental tissue and the adjacent teeth. [4]

This chemical process of erosion does not present alone or in an isolated way and could be associated with other alterations that cause tooth wear. Therefore, it is important to differentiate among abrasion, attrition and abfraction. Abrasion is the loss of dental tissue due to mechanical wear, with exogenous material, such as food or brushing, observed mainly in cervical areas, including cavities that have a greater width than depth with the exposure of the tooth root, and when it is masticatory, it is characterized by wear on both antagonistic teeth. Abfraction, on the other hand, is the microstructural loss of dental tissue in areas of stress concentration, causing stress efforts in cases of unbalanced chewing or parafunctional habits

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such as bruxism that lead to V-shaped dental tissue fractures in the cervical area. Abfraction usually occurs in the tooth that supports the chewing load during lateral movements. Attrition instead refers to the physiological wear of the hard tissues of the tooth crown that occurs as a result of the chewing process. It is a flat wear that is also observed in the antagonistic teeth and is aggravated in cases of parafunctional habits. When it occurs in teeth that have been restored with amalgam, resin or any other dental material, it is also affected, with wear on the dental tissue and the restorative material alike. [5]

In erosive lesions, dentin exposure occasionally stimulates secondary dentin formation; the exposure of dentin tubules can cause sensitivity to food and to cold or hot beverages, as well as tactile stimulation. The progression of erosive lesions can expose the pulpal tissue, causing irreversible pain. It is important to note that dental erosion etiology is multifactorial, from intrinsic or extrinsic origins, and involves chemical, biological, behavioral, and lifestyle factors.[6] Among the protective biological factors are saliva and the acquired film. The buffering capacity of saliva helps neutralize acids and favors an increase in pH, and the augmentation of the saliva flow allows the dilution of acids and separates them from the teeth. On the other hand, the acquired film acts as a permeable barrier and decreases direct contact with acids.[7,8]

An intrinsic chemical factor related to erosive lesions is the hydrochloric acid from the stomach of patients with gastroesophageal reflux, bulimia or anorexia. Extrinsic factors that have been related to dental erosion are varied and include sports beverages, carbonated or citric beverages, some types of teas, acidic foods, dressings, vinegars, and medications.[6]

In Mexico, few studies have been conducted on children's dental erosion (DE), and Mexican children have a high consumption of sweets, with a preference for acid and spicy flavorings. Among the most commonly used condiments are "chamoy" sauce (sweet and sour taste) and ketchup sauce (sweet taste), which are added to fruits and vegetables. [9] Another potential risk of erosion in Mexican children is the increase in the consumption of industrialized juice, which has tripled in terms of daily and weekly frequency in children.[10] Therefore, the objective of this study was to evaluate the prevalence of DE and its associated factors in schoolchildren aged 6 to 12 years.

MATERIALS AND METHOD

A transverse study was conducted on a convenience sample of schoolchildren aged 6 to 12 years old at a public school in Mexico City, according to the ethical guidelines established by the Helsinki Declaration and approved by the Ethics Committee of the Research Faculty of Zaragoza.

Information about the objective of the study was given to teachers, schoolchildren, and their parents so that they could grant their consent. Children were only included after their legal guardian signed the informed consent and answered a questionnaire about the child's medical history, diet, and hygiene habits.

The sample was calculated based on a previous DE pilot study in Mexican children with an alpha level of 0.05 and a 95% confidence interval (CI). The result of this calculation was n = 384. Additionally, a desertion rate of 7% was considered; thus, the size of the sample was augmented to 411 children.

Clinical exam and questionnaire

The clinical exam was conducted by a previously standardized pediatric dentist using an erosion index (Kappa = 0.74) after the children had their teeth brushed. A dental mirror, a dental probe (PCP11), and the artificial light from a headlamp were used. Clinical exams were conducted under the biosecurity principles of the patient.

To determine ED, the Smith and Knight index [11] was used, considering the vestibular, lingual, and occlusal surfaces for each tooth. Teeth with caries lesions or extensive restorations were excluded.

The standardized questionnaire was delivered to the children's parents or caretakers to identify their nutritional alterations with regard to regurgitation or vomiting, food habits, and frequency of acidic food and beverage intake, as well as treatments with medicines. The questionnaire also asked about the frequency and duration of tooth brushing and the type of toothbrush used.

Statistical Analysis

The statistical analysis of the collected data was performed using SPSS (Statistical Package for Social Sciences version 15). The association between ED and the risk factors was analyzed through the use of cross tabulation and odds ratios with a confidence interval (IC) of 95%. The participants were divided according to their age and their consumption of beverages or foods with low pH values. The differences among the groups were shown using Chi-square tests. Values of $p< 0.05$ were considered statistically significant.

RESULTS

A total of 411 schoolchildren were assessed: 197 boys (48%) and 214 girls (52%), with an average age of 8.4 ± 1.6 years old. Sixty-two percent of the children had dental wear due to DE. A greater prevalence was observed in the children aged 6 to 9 years (70%), which significantly differed from the prevalence of 40% observed in children aged 10 to 12 years ($p < 0.05$).

Table 1 shows the OR values for each of the beverages included in the questionnaire. DE was associated with the frequent consumption of probiotic beverages (OR: 1.658; CI 95%: 1.106-2.485; p = 0.014) and sports beverages (OR: 2.807; CI 95%: 1.129-6.983; p = 0.02). Additionally, as shown in Table 2, dental erosion was associated with the frequent consumption of fruits and snacks with hot peppers and lemon (OR: 1.594; CI 95%: 1.066-2.382; p = 0.023) and that of syrup (OR: 1.869; CI 95%: 1.060-3.296; p = 0.029) (Table 3). Additionally, the frequent consumption of natural juices (more than three times a week) was also related to dental erosion (OR: 3.344; CI 95%: 1.556-7.184; p = 0,003) (Fig. 3).

No associations were found between DE and the frequency or duration of tooth brushing, the type of toothbrush used, or the elapsed time between tooth brushing and food consumption or swimming practice.

Table 1. Consumption of beverages with acid pH values as a risk factor for dental erosion in schoolchildren in Mexico City

Variable	OR	CI 95%	p Value
Carbonated Soda			
High consumption	1.045	0.686 – 1.594	0.837
Bottled Juices			
High consumption	1.190	0.796 – 1.779	1.190
Natural Juices			
High consumption	1.273	0.843 – 1.922	0.251
Sports Beverages			
High consumption	2.807	1.129 – 6.983	0.021*
Probiotic Beverages			
High consumption	1.658	1.106 – 2.485	0.014*
Milk			
High consumption	1.682	0.579 – 4.891	0.334
Tea			
High consumption	1.070	0.716 – 1.597	0.742

Table 2. Consumption of food with acid pH values as a risk factor for dental erosion in schoolchildren in Mexico City

Variable	OR	CI 95%	p Value
Oranges			
High consumption	1.248	0.819 – 2.057	0.267
Lemons			
High consumption	1.067	0.642 – 1.775	0.802
Pineapples			
High consumption	0.979	0.655 – 1.464	0.919
Apples			
High consumption	1.292	0.798 – 2.091	0.297
Blueberries			
High consumption	1.019	0.630 – 1.649	0.938
Strawberries			
High consumption	1.206	0.797 – 1.823	0.365
Mayonnaise			
High consumption	1.012	0.673 – 1.523	0.953
Salad Dressings			
High consumption	1.988	0.829 – 4.769	0.118
Chamoy – Tamarind			
High consumption	1.224	0.804 – 1.862	0.346
Fruits and Snacks with Hot Peppers and Lemon			
High consumption	1.594	1.066 – 2.382	0.023*

Table 3. Risk factors for dental erosion in schoolchildren in Mexico City

Variable	OR	CI 95%	p Value
Swimming			
2 or more times monthly	0.849	0.478 – 1.508	0.577
Vomit			
2 or more times monthly	1.020	0.992 – 1.048	0.418
Vitamin C			
Yes	1.185	0.784 – 1.791	0.420
Frequent medication intake			
Yes	1.869	1.060 – 3.296	0.029*
Toothbrushing frequency (daily)			
2 or more times	0.753	0.452 – 1.255	0.275
Toothbrushing and food consumption (time between)			
Less than 30 minutes	0.688	0.450 – 1.030	0.069
Type of toothbrush			
Hard	0.708	0.473 – 1.058	0.091
Brushing duration			
More than 4 minutes	0.831	0.535 – 1.291	0.410

Figure 1. Dental erosion in second temporal molar.

DISCUSSION

In Mexico, as in other countries, the number of cases of DE in children has increased. In this study, 62% of the examined schoolchildren presented erosive lesions, which were more prevalent in the group of children aged 6 to 9 years old. This result can be explained by the number of years that the primary teeth were exposed to low pH values, which is not observed in older children in whom the change to permanent dentition has taken place. It is also important to note that primary teeth have a greater susceptibility due to a thinner enamel layer, greater organic content, and a lower degree of mineralization, all of which confer upon them the structural characteristics of lower resistance to acid attacks compared to permanent teeth.[12]

Figure 2. Dental erosion lesion in temporal canine and molar.

With respect to DE severity, in this study, a slight and/or moderate DE in the palatine surfaces of the anterior teeth and the occlusal aspects of the primary molar teeth was observed; this result differs from the findings of a study in Greek schoolchildren, in which 45% of the participants had moderate and/or severe dental erosion, which involves deep dentine close to the pulp.[13] Other studies have reported different prevalence estimates and degrees of severity, such as those from Australia (68%)[14] the Netherlands (30.4%)[15], Greece (45.6%)[13], Germany (45.4%)[16], and Brazil (51.6%),[17] which could be related to the differences in food habits in these populations.

In the present study, the frequent consumption of acidic beverages, such as probiotic beverages, sports beverages, and fruit juices, was significantly related to DE. This result is consistent with those of other studies that relate DE with the augmented consumption of these products due to their easy commercialization and low cost[18, 19]. This study found that the mothers of participant children frequently included in their children's diets beverages with fermented milk and with a content of *Lactobacillus casei* Shirota, which has a lower pH of 4.3[20]. Additionally, in Mexico, the consumption of beverages rich in electrolytes, such as in sports beverages, has become popular. These beverages have an acidic pH, and when they are ingested when the saliva flow is diminished after physical exertions, their demineralizing effect is augmented [21,21]. In vitro studies have demonstrated that the consumption of one carbonated and energizing beverage causes significant changes in the enamel surface compared to the changes associated with natural water intake[23].

In the analysis of the predictive factors of DE in the participating schoolchildren, a correlation was found between DE and the high-frequency consumption of fruit and/or snacks with hot peppers and lemon, as well as the consumption of medicines containing syrups. Mexican children like the taste of hot sauces that are prepared by mixing hot peppers, lemon and vinegar. Additionally, among the flavors preferred by Mexican children are tamarind and candies with sweet and bitter ingredients. This habit is shared by individuals in other Latin American countries; in fact, an association with dental erosion in Colombian adolescents has also been observed [24].

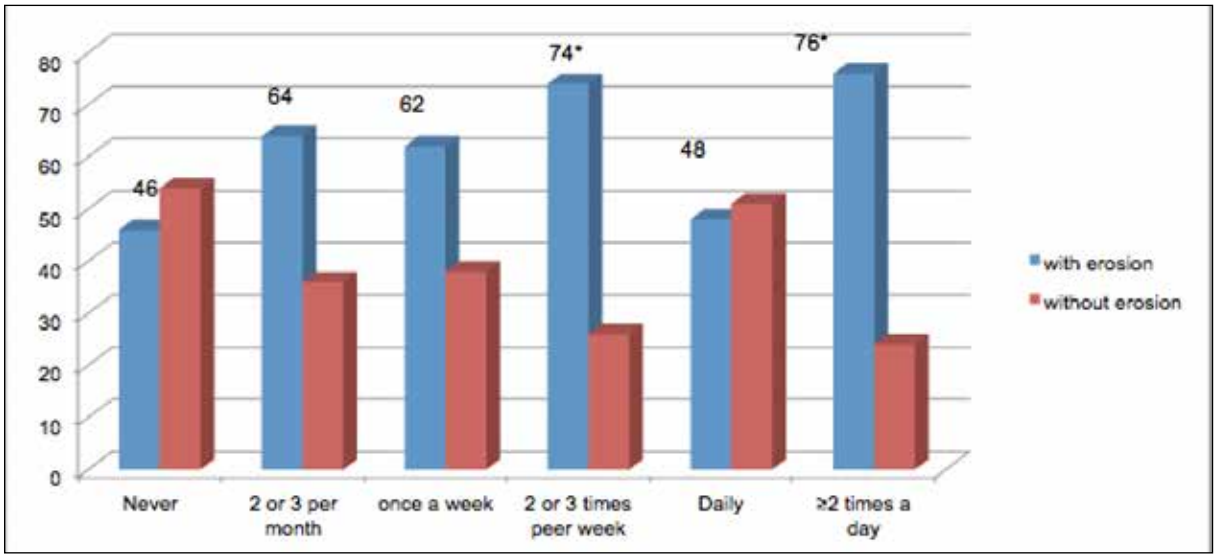

Figure 3. Association between frequent natural juice consumption and dental erosion. OR: 3.344; 95% CI: 1.556–7.184; p = 0.003.

On the other hand, pediatric patients with systemic illnesses, allergies, asthma, and other frequent sicknesses in childhood require a constant supply of antibiotics, histamines, bronchodilators, and corticosteroids, all of which augment the risk of lesions by dental erosion. In this respect, our findings coincide with those of other studies, in which an association has also been shown between dental erosion and medicinal syrups[25, 26].

Although Mexicans consume large quantities of carbonated sodas, in this study, there was no association between their consumption and the presence of dental erosion. In this respect, there exists controversy because some studies have identified these types of carbonated drinks as risk factors for DE[27 28], while the findings of other studies are consistent with the results of our study.[29] It is important to analyze the biological protective factors against DE, such as the flow and quality of saliva due to its buffering capacity in the neutralization of oral acids.

It is important to note that one of the limitations of this study was that it was based on the answers to a transversal form questionnaire; thus, to obtain more precision regarding the cause-and-effect relationships, the implementation of longitudinal studies is recommended.

The presence of dental wear due to erosion in primary dentition can predict a similar affectation in permanent dentition, which in turn will alter the quality of life of adolescents and adults. By analyzing the results of this work, we consider the observed high prevalence of DE to be linked to family lifestyles. Chili is among the foods frequently consumed in Mexico; thus, acid and spicy flavors are consumed from an early age. The importance of detecting this condition in pediatric patients lies in the promotion of a dietary orientation that considers the acidic pH of some foods and beverages. When evidence of dental erosion is detected, remineralizing treatments should be applied, and minimally invasive restoration should be used to preserve the integrity of the dental tissue and avoid the consequences of DE on oral health.

CONCLUSION

Dental erosion is a condition with a high prevalence in Mexican children and is associated with the consumption of acid beverages, fruits or snacks containing sauces with low pH values and medications in syrups. Parents should receive information about the risks of this type of food to diminish the prevalence of dental erosion, of which the consequences for oral health are hypersensibility, dental pain, and the loss of dental structures.

REFERENCES

1. Imfeld T. Dental erosion. Definition, classification and links. Eur J Oral Sci 103: 151-155, 1996.
2. Liñan-Duran C, Meneses-López A, Delgado-Cotrina L. Evaluación in vitro del efecto erosivo de tres bebidas carbonatadas sobre la superficie del esmalte dental. Rev Estomatol Herediana 17(2): 58-62, 2007.
3. López Ayuso A, Luminosa S, De la Fuente E, Moyaho A. Erosión dental en el esmalte de la dentición primaria por productos lácteos comerciales (estudio in vitro). AMOP 25(1): 108-111, 2013.
4. Lussi A. Dental erosion: from diagnosis to therapy. Library of Congress Cataloging publication data. Karger, Switzerland 1-9, 2006
5. Imfeld T. Dental erosion. Definition, classification and links. Eur J Oral Sci 103: 151-155, 1996.
6. Campos M, Furtado DC, Pedroso C. Control of erosive tooth wear possibilities and rationale. Braz Oral Res 23 (SI1): 49–55, 2009.
7. Bavbek AB, Dogan OM, Yilmaz T, Dogan A. The Role of Saliva in Dental Erosion and a Prosthetic Approach to Treatment: A Case Report. J Contemp Dent Pract 10(3): 1-8, 2009.
8. Lussi A, Schlueter N, Rakhmatullina E, Ganss C. Dental erosion – An overview with emphasis on chemical and hystopathological aspects. Caries Res (suppl 1): 2-12, 2011.
9. Wagoner S, Marshall T, WefweJ. In vitro enamel erosion associated with commercially available original and sour candies. J Am Assoc 140(7):907-913,2010.
10. Garcia P. La alimentación de los mexicanos. Cambios sociales y económicos y su impacto en los hábitos alimenticios. CANACINTRA, Mexico: Soluciones de comunicacion SC. 2012, 140 p.
11. Fajardo-Santacruz MC, Mafla-Chamorro AC. Diagnóstico y Epidemiología de Erosión Dental. Salud UIS 43(2): 179-189, 2011.
12. Hunter ML, West NX, Hughes JA, Newcombe RG, Addy M: Relative susceptibility of deciduous and permanent dental hard tissues to erosion by a low pH fruit drink in vitro. J Dent 28: 265-270, 2000.
13. Gatou T, Mamai-Homata E. Tooth wear in the deciduous dentition of 5 -7 years old children: risk factors. Clin Oral Investig 16(3): 923-933, 2012.
14. Kazoulis S, Seow S, Holcombe T, Newman B, Ford D. Common dental conditions associated with dental erosion in schoolchildren in Australia. Paediatr Dent 29(1): 33-39, 2007.
15. Halima A, Ewald M, Charlotte M. Dinamics of tooth erosion in adolescents: A 3 years longitudinal study. J Dent 38: 131-137, 2010.
16. Tschammler C, Muller -Pflanz C, Attin T, Muller J, Wiegand A. Prevalence and risk factors of erosive tooth wear in 3-6 years old German kindergarten children – A comparison between 2004-05 and 2014 -15. J Dent 52: 45-49, 2016.
17. Murakami C, Tello G, Abanto J, Butini L, Cunha G, Bönecker M. Trends in prevalence of erosive tooth wear in Brazilian preschool children. Int J Paedriatr Dent 1: 6-11, 2015.
18. Hunter L, Patel S, Rees J. The in vitro erosive potential of range of baby drinks. Int J Paediatric Dent 30:325-9,2009
19. Al-Malik M, Holt R, Bedi R. Erosion, caries and rampant caries in preschoolchildren in Jeddah, Saudi Arabia. Community Dent Oral Epidemiol 30;16-23,2002.
20. Mesquita-Guimaraes K, Scatena C, Borsatto M, Rodrigues-Junior A, Serra M. Effect of foods and drinks on primary tooth enamel after erosive challenge with hydrochloric acid. Braz Oral Res 29(1):1-7, 2015.
21. Sovik JB, Skudutyte-Rysstad R, Tveit AB, Sandvik L, Mulic A. Sour sweets and acidic beverage consumption are risk indicators for dental erosion. Caries Res 49: 243-250, 2015.
22. Fresno MC, Ángel P, Cisternas P, Muñoz A. Grado de acidez y potencial erosivo de las bebidas deportivas isotónicas disponibles en Chile. Rev Dent Chile 102(3): 13-16, 2011.
23. Kitchens M, Owens B. Effect of carbonated beverage, coffee, sports and high energy drinks and bottled water on the in vitro Erosion characteristics of Dental Enamel. J Clin Pediatr Dent 31: 153-159, 2007.
24. Mafla A, Cerón-Bastidas X, Munoz-Ceballos M, Vallejo-Bravo D, Fajardo- Santacruz M. Prevalence and extrinsic risk factors for dental erosion in adolescents. J Clin Pediatr Dent 41(2): 102-111, 2017.
25. Tupalli A, Satish B, Shetty B, Battu S, Kumar J, Nagaraju B. Evaluation of the erosive potential of various pediatric liquid medicaments: An in-vitro study. J Int Oral Health 6(1): 59-65, 2014.
26. Taji S, Seow W. A literature review of dental erosion in children. Aust Dent J 55: 358-367, 2010.
27. Salas M, Nascimento G, Vargas-Ferreira F, Tarquinio S, Huymans M, Demarco F. Diet Influence on tooth erosion prevalence in children and adolescents: Results of a meta-analysis and meta-regression. J Dent 43: 865-75, 2015.
28. Skalsky JM, Grindefjord M, Carlstedt K. Dental erosion, prevalence and risk factors among a group of adolescents in Stockholm County. Eur Arch Paediatr Dent 19(1): 23-31, 2018.
29. Wang P, Cai H, Hong J, You H. The prevalence of dental erosion and associated risk factors in 12-13 years old schoolchildren in Southern China. BMC Public Health 10: 478, 2010.