

**Prevalence of dental erosion in Pakistani children: A cross-sectional study**

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**Abstract:**

**Introduction:** Dental erosion has remained a topic of interest for more than a decade and now gripping greater attention with the rise in the number of cases being reported in children and young adults. Prevalence of dental erosion varies in different countries according to their different geographical locations, dietary habits and life styles of their people. However, little is known about the prevalence of tooth erosion in Pakistani children particular regarding the associated risk factors. Aims: This study was designed to explore the prevalence of dental erosion and to determine the associated predictors of dental erosion in school children of Pakistan aged 12 to 14 years.

**Methodology:** A comparative cross-sectional Analytical study was conducted at a private school of Karachi, Pakistan from April 2016 till March 2017. The subjects were selected on the basis of non-probability convenient sampling. Children aged 12-14 years were included for this study and children having frequent hospitalizations were excluded. The two previously calibrated examiners participated in the clinical examinations and visited the selected schools. The clinical examinations were performed in well-lit classrooms or in shaded places under natural light using plane mouth mirrors and sterilized cotton to remove debris. The central incisors, lateral incisors, and first molars in the upper and lower jaws were examined.

**Results:** School children were assessed by O'sullivan index which showed dental erosion of 42.8% on labial or buccal surface, 9.7% on lingual or palatal surface, 7.4% on occlusal or incisal, 4% on labial, incisal/occlusal and 7% on lingual, incisal/occlusal. Grade of severity of dental erosion showed normal enamel in 43.1%, matt appearance of enamel surface with no loss of contour in 20.1%, loss of enamel only in 35.8% and loss of enamel with exposure of dentine in 1%.

**Conclusion:** The study concludes that dental erosion is a multifactor in origin and with time is becoming increasingly commonly in younger age group. It is important that as health providers we need to identify the possible risk factors and make the community aware of the ways to prevent this condition.

**Key words:** Surfaces of teeth, enamel surface, Soft drinks and straw.

**Introduction:**

Dental erosion is the irreversible loss of hard mineralized tooth structure which results in a chemical etching and dissolution by acids without bacterial involvement<sup>1, 2</sup>. It is characterized by partial demineralization and the subsequent loss of an ultra-thin layer of enamel and exposure of the softer dentine every time an acid attack took place, which results in poor aesthetics, tooth hypersensitivity, dental abscess, severe loss of tooth surface, over closure and consequently reduced chewing function<sup>3, 5</sup>.

Dental erosion is now recognized as common occurring attention seeking risk factor in children's, adolescents and adults and has been on the increase during the last few decades<sup>6, 11</sup>. If dental erosion is prolonged and left untreated the child may suffer from severe tooth surface loss involving destruction of dentin and pulp resulting in tooth sensitivity and poor aesthetics<sup>5</sup>. Such a tooth wear and tear frequently demand strategies for prevention, restoration and rehabilitation that is often complex and costly adding to the family's and governments public's health burden<sup>12</sup>.

The etiology of dental erosion in children and adolescents is multi-factorial. These factors can be exogenous and endogenous. The exogenous sources can be soft drinks, carbonated beverages, citrus fruits, sports drink, acidic medication, acidic flavored candies, vinegar conserves and acidic herbal teas. The intrinsic sources include gastro-esophageal reflexes causing erosion of tooth surface due to the interaction of gastric juices with the tooth surfaces.<sup>13,16</sup>

There is still lack of awareness regarding dental erosion among adults and school going children. Not only the common people but the dental professionals also confuse the sign and symptoms of dental erosion<sup>17</sup>. A recent study conducted in China indicates the prevalence of dental erosion among school children to be 27.3%<sup>18</sup>. No significant studies have been conducted in Pakistan to measure the widespread

prevalence of dental erosion in Pakistan. Early diagnosis and prevention are the need of time therefore this study focuses on the prevalence of dental erosion among school going children in Karachi, Pakistan. This study examined the etiological role of risk factors recognized to be relevant to the onset of dental erosion and socioeconomic status in developed societies faced by school children in Pakistan

**Methodology:**

This comparative cross-sectional study was conducted at a private school of Karachi, Pakistan from April 2016 till March 2017. The subjects were selected on the basis of non-probability convenient sampling. Children aged 12-14 years were included for this study and children having frequent hospitalizations were excluded.

**Sample size:** The sample size calculation was done using the W.H.O. software for "Sample Size Calculation" edited by L. Lemeshow and S. K. Lwanga. The reference study used for this sample size calculation is: Ping Wang, Huan Cai Lin, Jian Hong Chen, Huan You Liang. "The Prevalence of dental erosion and associated risk factors in 12-13-year-old school children in Southern China." BMC Public Health. 2010 Aug 12; 10:478.

1.3a. Hypothesis tests for a population proportion (one-sided test)

Please select the desired unknown:

- Level of significance (%)
- Power of the test (%)
- Test value of the population proportion
- Anticipated value of the population proportion
- Sample size

Please enter the remaining values:

- α [ 5 ]
- 1 - β [ 90 ]
- P<sub>0</sub> [ 0.27 ]
- P<sub>1</sub> [ 0.35 ]
- n [ 282 ]

$$n = \frac{\{z_{1-\alpha} \sqrt{P_0(1-P_0)} + z_{1-\beta} \sqrt{P_1(1-P_1)}\}^2}{(P_1 - P_0)^2}$$

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The results of this study are valid as confirmed by sample size calculation using W.H.O. software for sample size calculation, where  $\alpha = 5\%$ ,  $1 - \beta = 90$ ,  $Po = 0.27$ ,  $Pa = 0.35$ ,  $n$  (sample size) = 282. The researcher recruited 299 subjects to avoid the chances of type 2 error.

**Clinical Examination:** The two previously calibrated examiners participate in the clinical examinations and visited the selected schools. The clinical examinations were performed in well-lit classrooms or in shaded places under natural light using plane mouth mirrors and sterilized cotton to remove debris. The central incisors, lateral incisors, and first molars in the upper and lower jaws were examined. The Diagnostic criteria of dental erosion proposed by Eccles were used in this study<sup>(6)</sup>. The index of O’Sullivan was adopted to record the distribution, severity, and number of affected teeth<sup>(7)</sup>. This index is especially designed for epidemiologic surveys and for the diagnosis of erosion in children to determine treatment options. O’Sullivan index for measurement of dental erosion:

Site on erosion on each tooth (make a Variable of Presence or Absence of erosion)

Code A: Labial or buccal only

Code B: Lingual or palatal only

Code C: Occlusal or incisal only

Code D: Labial and incisal/occlusal

Code E: Lingual and incisal/occlusal

Code F: Multi-surface

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

Code 0: Normal enamel

Code 1: Matt appearance of the enamel surface with no loss of contour

Code 2: Loss of enamel only (loss of surface contour)

Code 3: Loss of enamel with exposure of dentine (enamel-dentin junction visible)

Code 4: Loss of enamel and dentine beyond enamel-dentine junction

Code 5: Loss of enamel and dentine with exposure of the pulp

Code 9: Unable to assess (e.g. tooth crowned or large restoration)

Area of surface affected by erosion

Code -: Less than half of surface affected

Code +: More than half of surface affected

**Questionnaire:** The school children completed a question at the schools prior to the clinical examination. The questionnaire was designed to reflect the socio-economic status, behavioral factors, and general health involved in the etiology of erosion, as proposed by Lussi and in other studies<sup>(3, 8, 9)</sup>. The pilot study was carried out to test and refine the questionnaire.

The questionnaire included questions about general information (gender and age), socio-economic status, occupation and education levels of the parents, oral hygiene habits, frequencies of ingesting certain beverage types, amount of acidic drink intake per week (including carbonated drinks, sport drinks, lemon tea, and fruit juices), special drinking habits, general health (including frequency of vomiting and heartburn or nausea in this study), and vitamin C supplements.

**Statistical analysis:** The study data were entered into a computer using SPSS software (version 20) and analyzed.

Descriptive analysis was conducted to describe the prevalence and characteristics of dental erosion. A two-step approach was used to analyze risk factors of dental erosion. First, bivariate analysis was used to test the relationship between dental erosion and the associated factors. Then, a binary logistic regression analysis was used to analyze the factors that were independently related to the presence of erosion. The variables ( $p < 0.5$ ) in the bivariate analysis were entered into a logistic regression model in an enter fashion. The level of statistical significance was set at 5%.

### Results:

School children were assessed by O’Sullivan index which showed dental erosion of 42.8% on labial or buccal surface, 9.7% on lingual or palatal surface, 7.4% on occlusal or incisal, 4% on labial, incisal/occlusal and 7% on lingual, incisal / occlusal surfaces (Table 01).

Table 1: Prevalence of dental erosion by O’Sullivan index.

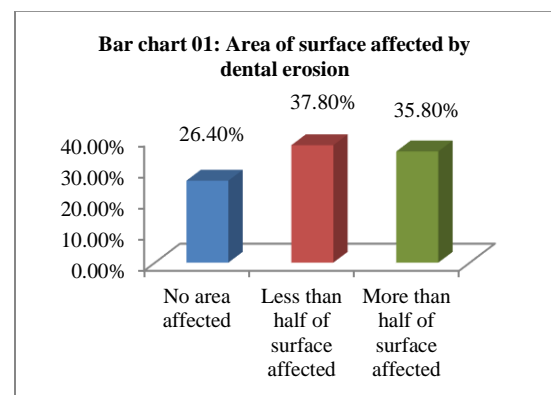
Variables	Frequency	Percent
Code A Labial or Buccal only	128	42.8
Code B Lingual or Palatal only	29	9.7
Code C Occlusal or incisal only	22	7.4
Code D Labial and incisal/occlusal	12	4
Code E Lingual and incisal/occlusal	21	7
Code F Multi-surface	52	17.4

Grade of severity of dental erosion showed normal enamel in 43.1%, matt appearance of enamel surface with no loss of contour in 20.1%, loss of enamel only in 35.8% and loss of enamel with exposure of dentine in 1% (Table 02).

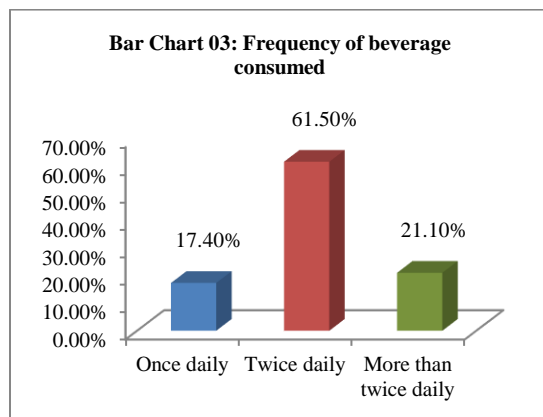
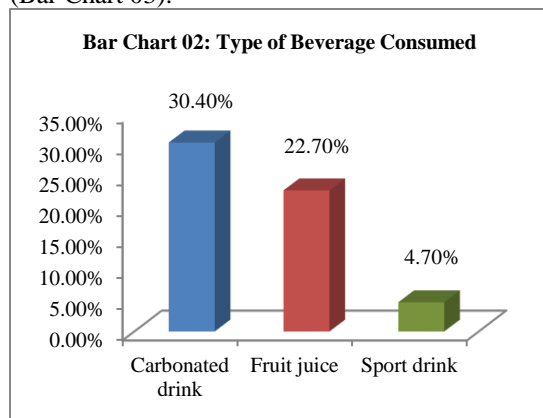
Table 2: Grade of severity of dental erosion.

Variables	Frequency	Percent
Normal enamel	129	43.1
Matt appearance of enamel surface with no loss of contour	60	20.1
Loss of enamel only	107	35.8
Loss of enamel with exposure of dentine	3	1.0

Area of surface affected by dental erosion showed 26.4% of no area affected, 37.8% in less than half of surface affected and 35.8% in more than half of surface affected (Bar Chart 01).



Type of beverage consumed showed 30.4% of carbonated drink, 22.7% of fruit juice and 4.7% of sport drink (Bar Chart 02). Frequency of beverage consumed showed 17.4% once daily, 61.5% twice daily and 21.1% more than twice daily (Bar Chart 03).



Frequency of tooth brushing once a day in school children had a high prevalence of dental erosion as compared to school children brushing their teeth more than once respectively (132/299; 44.1% v 167/299; 55.9%,  $p$ -value = 0.03). School children tooth brushing once a day had 1.75 times more, (95% CI, 1.03-3.00) the risk of dental erosions as compared to school children tooth brushing more than once. School children tooth brushing less than one-minute duration had a high prevalence of dental erosion as compared to school children tooth brushing more than one minute respectively (165/299; 55.2% v 134/s299; 44.8,  $p$ -value = 0.002). School children tooth brushing less than one-minute duration had 2.24 times more, (95% CI, 1.32-3.79) the risk of dental erosions as compared to school children tooth brushing more than one minute.

School children consuming carbonated drinks had a high prevalence of dental erosion as compared to school children drinking fruit juices and sport drinks respectively (128/299; 42.8% v 171/299; 57.2%,  $p$ -value = 0.02). School children consuming carbonated drinks had 1.90 times more, (95% CI, 1.10-3.27) the frisk of dental erosions as compared to school children drinking fruit juices and sport drinks. School children consuming more than once daily beverages had a high

prevalence of dental erosion as compared to school children consuming beverages once daily respectively (157/299; 52.5% v 142/299; 47.5%,  $p$ -value = 0.013). School children consuming more than once beverages had 1.93 times more, (95% CI, 1.146 – 3.259) the risk of dental erosions as compared to school children consuming less than once daily beverages.

School children consuming beverages with straw had a high prevalence of dental erosion as compared to school children consuming beverages without straw respectively (167/299; 55.9% v 132/299; 44.1%,  $p$ -value = 0.002. School children consuming beverages with straw had 2.24 times more, (95% CI, 1.32 – 3.79) times the risk of dental erosions as compared to school children consuming beverages without straw (Table 03).

Table 3: Probability of dental erosion-Binary Logistic Regression Analysis

Variables	Odds ratio (95% confidence interval)	$p$ -values
Frequency of tooth brushing in school children with dental erosion (ref= school children with no dental erosion)	1.75 (1.03-3.00)	0.03
Duration of brushing in school children with dental erosion (ref= school children with no dental erosion)	2.24 (1.32-3.79)	0.002
Type of beverage in school children with dental erosion (ref= school children with no dental erosion)	1.90 (1.10-3.27)	0.02
Frequency of beverage consumed in school children with dental erosion (ref= school children with no dental erosion)	1.93 (1.146 – 3.259)	0.013
Method of beverage consumed with straw in school children with dental erosion (ref= school children with no dental erosion)	2.24 (1.32 – 3.79)	0.002

### Discussion:

In our study we selected incisors and molars to see the possible effects of dental erosion because lower permanent molars appear first in the mouth and may subjected to the effects since long whereas the incisors are the teeth which are more exposed to the etiological factors of erosion.

The results from the current study indicate involvement of the buccal surfaces of teeth by dental erosion in 42.8% of cases, this shows that these surfaces are readily exposed to the effects of acids.

It can be seen that in majority of the teeth affected by dental erosion, less than half of the surface of the tooth is involved and also only enamel is involved. This can be attributed to the activity of the related soft tissues in mouth such as tongue and cheeks. A detailed study is required to explain this.

Erosion experience was also found to be associated with the dietary habits of the individuals particularly the consumption of beverages such as fruit juices, carbonated drinks and sports drinks. Of these different types, carbonated drinks appear to be the highest risk factor because they have a lower pH as compared to other drinks. Also, it can be seen that the frequency of consumption is directly related to the prevalence of dental erosion. The greater the number of times an acidic product is consumed the greater exposure of tooth to the acidic insult. In this research the influence of socioeconomic group on prevalence of dental erosion was not considered, therefore, a further study is required to see the possible association of lifestyles on occurrence of dental erosion.

The way in which an acidic food or drink is consumed also affects the occurrence of dental erosion, as can be seen in this study the individuals consuming the carbonated drinks with straw have greater prevalence of dental erosion as compared to those who consume it without straw. This is because when taken with straw the acidic product comes in direct contact with the surface of the teeth and also it takes longer time for the individual to finish the drink with straw, so the teeth remain bathed in the acid for longer duration as compared when straw is not being used. When an individual directly drinks the acid mainly comes in contact with the soft tissues and is immediately swallowed and remains in mouth for less time for acid to start dissolution of enamel.

Through this study there is a strong role of frequency and duration tooth brushing in the control of dental erosion. Children brushing their teeth twice daily and for more than one minute have lesser prevalence of dental erosion as compared to those who brush only once and for less than one minute. This is related to the neutralizing and rematerializing effect of the ingredients in a dentifrice.

### Recommendations:

Dental erosion is a multifactorial condition which with time is becoming increasingly common in younger age group. As health providers it is our responsibility to identify the possible risk factors and make the community aware of the ways to prevent this condition.

Dietary counseling is of particular importance. This may be tailored to the individual and is only possible after diet has been thoroughly assessed. Instructions such as limiting the acidic foods and drinks to meal time and their avoidance at night times due reduced buffering activity of saliva at night time, should be stressed. Habits such as frothing or swishing the drink around the mouth or drinking in small sips should be avoided. Rather the drinks should be consumed quickly to reduce the time for which the acid comes in contact with the teeth. If a straw is used it should be wide bore and kept at the back of the mouth in order to reduce the contact area between the acid and the teeth. After consumption of an acidic food or drink the tooth surface becomes increasing porous if at this time tooth brushing is done immediately it would lead to rapid loss of enamel surface, it would be damage rather than a benefit. Therefore, a delay in brushing of half an hour to an hour will be helpful in preventing to both surface loss.

Conflicts of interest:

The authors declare that there are no conflicts of interest. The study was funded by a grant from the Liaquat College of Medicine and Dentistry & Darul Sehat Hospital.

### Author's contribution

MN and NN designed the study, conceived the idea for the paper, and conducted the statistical analysis;

NN and TA conducted the clinical examinations;

TM, NN and MN entered that data and assisted during the examinations and the field work;

TM and MN assisted in the statistical analysis and the interpretation of the results;

TA, NN and MN conducted the literature review and drafted the manuscript.

All authors reviewed and approved the manuscript.

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