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Risk Factors and Management of Dental Erosion and Traumatic Dental Injuries among School Children

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Abstract

Background
Dental erosion and traumatic dental injuries (TDIs) are increasingly prevalent oral health problems among children, particularly in low- and middle-income countries where preventive dental services are limited. These conditions can adversely affect oral function, esthetics, and quality of life if not identified and managed early.

Objectives
To determine the risk factors of dental erosion and traumatic dental injuries among school-going children.

Methods
A cross-sectional analytical study was conducted among 360 children aged 6 to 12 years selected through multistage random sampling from public and private schools. Dental erosion and TDIs were assessed clinically using standardized criteria. Data on sociodemographic characteristics, dietary habits, oral hygiene practices, trauma history, and treatment-seeking behavior were collected using a structured questionnaire. Data was analyzed using descriptive statistics, chi-square tests, and multivariable logistic regression analysis.

Results
The prevalence of dental erosion was 33.1%, while traumatic dental injuries were observed in 21.4% of children. Frequent consumption of carbonated drinks, brushing less than twice daily, and lower parental education were significant predictors of dental erosion ($p < 0.05$). Male gender, participation in outdoor sports, and increased overjet

were significantly associated with TDIs ($p < 0.05$). Only 39.0% of children with TDIs received professional dental treatment.

Conclusions

Dental erosion and traumatic dental injuries are common among Pakistani children and are influenced by modifiable behavioral and environmental factors. School-based preventive programs and improved parental awareness are urgently needed.

Introduction

Oral health is an essential component of overall health and well-being, particularly during childhood (1). Dental professionals play a pivotal role in promoting preventive oral health behaviors within the community. Dental students, as future oral health care providers, are expected to demonstrate exemplary oral hygiene practices and possess adequate knowledge regarding dental health maintenance (2). Their personal oral health behaviors not only reflect their level of awareness but also influence their professional attitudes and patient education practices (3,4). In Pakistan, childhood oral health problems remain largely neglected, with limited access to preventive and restorative dental care (5). Among the various oral conditions affecting children, dental erosion and traumatic dental injuries (TDIs) emerge as important public health concerns (6). Dental erosion is defined as the irreversible loss of hard dental tissues caused by chemical processes without bacterial involvement, primarily due to frequent exposure to dietary or intrinsic acids. Tooth loss in adults, children and adolescents is mainly due to erosion. Erosion can be localized, chronic, pathological and irreversible (7,8).

Dental erosion is now recognized as a common and increasingly important risk factor affecting children, adolescents, and adults. If dental erosion is prolonged and left untreated, children may suffer severe tooth surface loss involving dentin and pulp, resulting in tooth sensitivity and compromised esthetics. Such a tooth wear and tear often will demand strategies for prevention, restoration and rehabilitation which are often complex and expensive adding to the family's and Governments public's health burden (9). In Pakistan, the increasing availability and consumption of carbonated beverages, packaged fruit juices, and acidic snacks have contributed to a rising risk of dental erosion among children (10).

Traumatic dental injuries (TDIs) are among the most common oral health problems of children and adolescents worldwide especially in the mixed dentition period (11). This transitional phase and with the existence of primary and permanent teeth, usually occurs at the age of 6 to 12 years, and is usually accompanied by an increased susceptibility to dental trauma due to the development of motor coordination, active play and participation in sports and outdoor activities. Injuries sustained during this period may have long term functional, aesthetic and psychological consequences if not promptly and adequately managed (12). Traumatic dental injuries, commonly resulting from falls, sports activities, and road traffic accidents, are also frequently reported in school-aged children (13). However, Pakistani data on the combined burden, predictors, and management patterns of these conditions remain scarce. Understanding these factors is crucial for developing effective prevention and intervention strategies. Therefore, this study aimed to assess the prevalence, predictors, and management of dental erosion and traumatic dental injuries among school-going children in Pakistan.

METHODOLOGY

A cross-sectional analytical study was conducted among school-going children aged 6–12 years. This age group represents the mixed dentition period and is considered highly susceptible to both dental erosion and traumatic dental injuries. The sample size was calculated using the standard prevalence formula, assuming an anticipated prevalence of 30%, a 95% confidence interval, and a margin of error of 5%. The minimum required

sample size was 323 children. To account for non-response and incomplete data, a 10% increase was applied, resulting in a final sample size of 360 children. A multistage random sampling technique was employed. In the first stage, six schools (three public and three private) were randomly selected from an urban district in Pakistan to ensure socioeconomic representation. In the second stage, eligible children were selected using systematic random sampling from class registers. Children aged 6–12 years whose parents or guardians provided written informed consent were included. Children with systemic diseases affecting tooth structure, developmental enamel defects, ongoing orthodontic treatment, or incomplete questionnaire data were excluded.

Clinical examinations were conducted under natural daylight using sterile mouth mirrors and probes. Dental erosion was assessed using a simplified erosion index, while traumatic dental injuries were recorded according to the World Health Organization classification. A structured, pre-tested questionnaire was administered to parents to collect data on demographic variables, dietary habits, oral hygiene practices, trauma history, and dental treatment. The examiner was calibrated prior to data collection, with intra-examiner reliability showing a kappa value of 0.82. Ethical approval was obtained from the institutional review board, and confidentiality was maintained throughout the study. Data were analyzed using SPSS version 25. Descriptive statistics were calculated, chi-square tests assessed associations, and multivariable logistic regression identified independent predictors. Statistical significance was set at $p < 0.05$.

RESULTS

A total of 360 children participated in the study, with a mean age of 9.2 ± 1.7 years. Of these, 190 (52.8%) were males and 170 (47.2%) were females.

Table 1: Demographic Characteristics of Study Participants (n = 360)

Variable	Frequency	Percentage (%)
Age Group		
6–8 years	138	38.3
9–10 years	124	34.4
11–12 years	98	27.3
Gender		
Male	190	52.8
Female	170	47.2
School Type		
Public	198	55.0
Private	162	45.0

Dental erosion was observed in 119 children, giving a prevalence of 33.1%.

Table 2: Distribution of Dental Erosion According to Risk Factors

Variable	Erosion Present n (%)	Erosion Absent n (%)	p-value
Carbonated drinks ≥3/week	78 (65.5)	64 (26.7)	<0.001
Brushing <2 times/day	71 (59.7)	69 (28.7)	0.002
Low parental education	66 (55.5)	73 (30.4)	0.004

Traumatic dental injuries were identified in 77 children (21.4%).

Table 3: Types and Causes of Traumatic Dental Injuries

Variable	Frequency	Percentage (%)
Type of Injury		
Enamel fracture	39	50.6
Enamel-dentin fracture	26	33.8
Luxation injuries	12	15.6
Cause of Injury		
Falls	34	44.2
Sports activities	27	35.1
Road traffic accidents	16	20.7

Table 4: Multivariable Logistic Regression Analysis of Predictors

Predictor	Adjusted OR	95% CI	p-value
Acidic drinks (erosion)	2.31	1.42–3.76	0.001
Poor brushing (erosion)	1.88	1.15–3.06	0.012
Male gender (TDI)	2.05	1.19–3.51	0.009
Outdoor sports (TDI)	2.47	1.41–4.31	0.002
Increased overjet (TDI)	1.94	1.10–3.42	0.021

Table 5: Management of Dental Erosion and TDIs

Management Aspect	Frequency	Percentage (%)
Children with TDIs receiving dental care	30	39.0
Restorative treatment provided	22	28.6
Preventive counseling for erosion	34	28.6
No treatment sought	47	61.0

DISCUSSION

The present study provides comprehensive evidence on the prevalence, risk factors, and management practices related to dental erosion and traumatic dental injuries (TDIs) among school-going children in Pakistan. The findings indicate that both conditions represent significant oral health challenges during the mixed dentition period and are influenced by modifiable behavioral, environmental, and anatomical factors (6). The prevalence of dental erosion observed in this study (33.1%) is consistent with previous studies conducted among Pakistani school children, which have reported prevalence rates between 30% and 38% (7,8). Similar trends have also been reported internationally, particularly in low- and middle-income countries experiencing dietary transitions toward increased consumption of acidic beverages and processed foods (6). Frequent intake of carbonated drinks emerged as a strong predictor of dental erosion, reinforcing the established role of extrinsic acids in the chemical dissolution of dental hard tissues (7,8). Inadequate oral hygiene practices, particularly brushing less than twice daily, were significantly associated with dental erosion (14). Although erosion is not bacterial in origin, poor oral hygiene may exacerbate enamel softening and delay remineralization, thereby increasing susceptibility to tooth surface loss (15). Additionally, lower parental education was identified as a significant predictor, suggesting that limited awareness and health literacy influence children's dietary choices and oral hygiene behaviors (16). The prevalence of TDIs in the present study was 21.4%, which aligns with national and regional studies reporting rates between 18% and 25% among school-aged children (17). Male children were significantly more affected, a finding consistently reported in the literature and attributed to greater participation in physical and outdoor activities (13,17). Falls and sports-related injuries

were the most common causes of TDIs, emphasizing the need for preventive interventions in school and playground settings (6).

Increased overjet was identified as an independent predictor of TDIs, corroborating earlier studies that have demonstrated a strong association between dental trauma and protrusive incisors (18). Children with increased overjet are more vulnerable to direct trauma during falls or collisions, highlighting the preventive role of early orthodontic assessment and intervention in high-risk individuals (12). Another finding of this study was the low proportion of children with TDIs who received professional dental care (39%). This reflects barriers such as limited access to dental services, lack of parental awareness regarding the urgency of trauma management, and socioeconomic constraints (19). Similar patterns of delayed or absent treatment for TDIs have been reported in Pakistani studies, leading to long-term functional, esthetic, and psychological consequences (11,12). Overall, the findings highlight the urgent need for school-based oral health promotion programs, parental education initiatives, and integration of preventive dentistry into primary healthcare services. Emphasis should be placed on reducing the consumption of acidic beverages, improving oral hygiene practices, promoting safe play environments, and ensuring timely management of dental trauma.

CONCLUSION

Dental erosion and traumatic dental injuries are common among school-going children in Pakistan and are largely influenced by modifiable behavioral and anatomical risk factors. Frequent consumption of acidic beverages, poor oral hygiene practices, male gender, outdoor activities, and increased overjet were significant predictors. Despite this, utilization of professional dental care particularly after dental trauma remains low. Strengthening school-based preventive programs, improving parental awareness, and promoting early risk identification are essential to reduce long-term oral health consequences.

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