Research Article

Prevalence and Associated Risk Factors of Dental Erosion among 6-7-Year-Old Children in Davanagere city: A Cross Sectional Survey

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Abstract

Background: Dental erosion is an increasing oral health concern among children. Knowing the risk factors and regional prevalence is critical for its prevention. Aim of the study was to assess the prevalence and severity of dental erosion and its potential predictors among 6-12 years old school children in Davangere city.

Methods: A cross sectional study was designed and conducted in a field setting involving randomly selected sample of 800 children. Data regarding socio-demographic details, medical history, oral hygiene practices, dietary patterns, was collected by using questionnaire and dental erosion was assessed using O'Sullivan Index and Basic Erosive Wear indices. IBM SPSS Statistics for Windows, version 20, was used for analysis. Significance level was fixed at P < 0.05. Chi Square test and Logistic regression tests were applied to find association and prediction respectively.

Results: Prevalence of dental erosion was 4.5% among 6-12-year-old children. It was higher in primary dentition(14.2%)compared to mixed(1.1%) and permanent dentition(10.2%).High prevalence of dental erosion was significantly associated (p,0.05) with middle class socioeconomic status, primary dentition, gastro-esophagial reflux, frequent consumption of jam and soft drinks with snacks. Logistic regression indicated that dental erosion was less in permanent dentition (OR = 0.08, 95% CI- 0.03-0.23, P = 0.00) and high in children engaged in sports other than swimming (OR-4.3, 95% CI- 0.96-19.39, P = 0.05. Interpretation and conclusion: Prevalence of dental erosion was less among 6-12year old school children in Davanagere city. Dental erosion was more prevalent in deciduous dentition compared to mixed and permanent.

Keywords: Children; Dental Erosion; India; Predictors; Prevalence

Introduction

Prevalence of tooth wear in children increases with age, reaching up to 80% by the end of primary dentition and gradually decreasing to about 30% in adolescents with permanent dentition according to few systematic reviews [1,2]. To prevent and manage dental erosion in children, it's critical to understand the risk factors and diagnose them early. If left untreated, dental erosion can lead to dentinal hypersensitivity, cosmetic issues, and a loss of vertical dimension, all of which have an impact on oral health and quality of life [3]. Few cross-sectional epidemiological studies done in India have shown that in children, the prevalence of erosion ranges from 8% to 42% [4-6]. World Health Organization (WHO) has recognized tooth erosion as a public health problem and included it in the 5th edition of its manual [7].

The etiology of dental erosion is multifactorial from extrinsic and intrinsic factors involving biological, chemical, lifestyle and behavioural factors. The protective factors include saliva, which buffers the acidic environment in oral cavity and acquired pellicle which acts as protective barrier on the tooth surface and prevents permeability of acids. Intrinsic factor implicated in erosion are, gastroesophagial reflux, bulimia or anorexia and extrinsic factors are consumption of sports beverages, carbonated or citric beverages, some types of teas, acidic foods, dressings on fruit and vegetables, vinegars, spicy flavourings, commercial sauce, ketchup sauce and medications [8]. Identifying the prevalence, severity and risk factors of erosion in children allows for a greater understanding of these factors at a regional level and provides a strong baseline data which may serve in planning preventive and health promotive

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strategies suitable to that region. Hence, a cross sectional survey was planned, with the aim to assess the prevalence and severity of dental erosion among 6-12 years old school children in Davanagere city, by clinical examination (O'Sullivan Index and Basic Erosive Wear Examination) and determine risk factors associated with erosion of teeth with the help of questionnaire.

Materials and Methods

Cross sectional survey involving 800 school children aged between 6-12 years was carried out in a school setting from January 2019-December 2019. Before the conduct of study, ethical clearance was obtained from institutional review board of Bapuji Dental College and Hospital, Davangere [ref no: BDC/Exam/467/2018-19 dated 23-11-2018].Sample size was calculated using the formula $n = p(1-p) \times [(z_1-\alpha/2 + z_2-\beta)/p-q] \times 2$, [9] where n- calculated sample size, p = 0.55 (expected prevalence of erosion), q = 1-p,α = 0.05 (significance level),β = 0.8(type 2 error),1-β = 0.2(power of the study. Children aged between 6-12 years of age with no physical or mental impediment to cooperation during the clinical examination were included in the study. Children without parental consent, who were un cooperative during the clinical examination and children with orthodontic appliances, extensive restorations and enamel defects accompanied by loss of tooth structure, fractured or missing incisors were not eligible to participate in the study. Multistage sampling technique was followed to select the study participants. Davangere city was arbitrarily divided into north and south zones. From each zone, two private and two public schools were randomly selected and from each school 100 students were randomly selected thus making a total of 800 children. Voluntary informed parental consent was obtained from the parents of children participating in the study prior to study and assent was obtained from children before their clinical examination.

Data collection was done using pretested and validated proforma which was framed in local language. Proforma had the provision to record demographic details, medical history, oral hygiene practices, dietary habits and details of sport activities of study participants which was collected based on their parents' responses.

There was provision to record findings of dental erosion using O'Sullivan Index [10] for primary teeth and Basic Erosive Wear Examination Index for permanent teeth [11]. A single qualified and calibrated examiner conducted the examinations. A mouth mirror, CPI probe were and cotton rolls were used for clinical examination of teeth which was carried out in daylight. Occlusal, buccal, palatal/lingual surfaces of teeth were examined for presence of erosion.

Statistical analysis of the data was done using IBM SPSS Statistics for Windows, Version 20.0. Armonk, NY: IBM Corp. Significance level was fixed at p ≤ 0.05. Chi-square test was performed to check for significant differences between categorical variables. Frequency distribution analysis was performed to evaluate the prevalence of erosion. Logistic regression analysis was performed to identify the risk factors and predictors of erosion.

Results

A total of 800 children with mean age 9.18 ± 2.0 years participated in the study. The overall prevalence of dental erosion among 6-12-year-old study participants was 4.5%. There was no significant difference (p > 0.05) in the distribution of sociodemographic, oral hygiene and diet related factors across study participants except: socioeconomic status; type of dentition; frequency of jam and soft drinks with snacks consumption; children with Gastroesophagial reflux and sports. (Table 1). Bivariate analysis indicated that high prevalence of dental erosion was associated with middle class socioeconomic status (p = 0.04), Gastroesophagial reflux (p = 0.00), primary dentition (p = 0.00), frequent consumption of jam (p = 0.02), frequent consumption of soft drinks with snacks (p = 0.01) and sports other than swimming (p = 0.00) (Tables 2 and 3). There was no significant difference (p > 0.05) in the mean O'Sullivan scores and highest O'sullivan score per child score between primary and mixed dentition children. According to O'Sullivan index, dental erosion was seen on buccal, palatal, labial and incisal surfaces. Code 2 (loss of enamel only) was more prevalent (50%) and code - (less than half of tooth surface was involved in majority of affected children (Table 4).

Socio-demographic variables	Number of subjects (%)	Chi square value	P value
Gender		0.51	0.50
Male	387 (48.4)		
Female	413 (51.6)		
Type of Dentition		50.94	0.00*
Primary	120 (15.0)		
Mixed	552 (69.0)		
Permanent	128 (16.0)		

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Location			
North	400 (50)	0.465	0.495
South	400 (50)		
Type of School			
Government	400 (50)	0.001	1.00
Private	400 (50)		
Socioeconomic status			
Low	325 (40.6)		
Middle	355 (44.4)	6.40	0.004*
High	120 (15.0)		
Oral hygiene variables			
Frequency of brushing habit			
Once a day	613 (76.6)	0.028	0.867
Twice or more	187 (23.4)		
Brushing Aid			
Toothbrush	796 (99.5)	0.189	0.664
Finger	4 (0.5)		
Brushing material			
Paste	797 (99.6)	0.707	0.142
Others	03 (0.4)		
Dietary variables			
Type of Diet			
Vegetarian	376 (47.0)	0.430	0.512
Mixed	424 (53.0)		
Frequency of biscuit consumption			
Several times a day	366 (45.8)		
Once/Several times a week	121 (48.1)	2.384	0.304
Seldom/Never	49 (6.8)		
Frequency of Jam Consumption			
Several times a day	102 (12.8)		
Once/Several times a week	393 (49.1)	7.385	0.025*
Seldom/Never	305 (38.1)		
Frequency of Sweet Consumption			
Several times a day	222 (27.8)		
Once/Several times a week	487 (60.9)	1.102	0.576
Seldom/Never	91 (11.4)		
Frequency of citrus fruits consumption			
Several times a day	224 (28.4)		
Once/Several times a week	482 (60.3)	4.971	0.083
Seldom/Never	94 (11.8)		
Types of Soft Drinks preferred			
Carbonated	201 (25.1)		
Non-Carbonated	599 (74.9)	0.000	0.986
Method of Consumption			
Using Straw	153 (19.1)		
Gulping only	422 (52.8)	0.472	0.790
Both ways	225 (28.1)		

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Snacks consumption with soft drinks			
Yes	139 (17.4)		
No	519 (64.9)	7.988	0.005*
Sometimes	142 (17.8)		
Time of Consumption of soft drinks			
In Morning/In between meals/At night	583 (72.9)		
With meals	217 (27.1)	2.636	0.104
Health and Lifestyle variable			
Medical Disease:			
Yes	1 (0.1)	0.047	0.83
No	799 (99.9)		
Medicine Consumed:			
Yes	1 (0.1)	0.047	0.83
No	799 (99.9)		
Vitamin C:			
Yes	0 (0.0)	-	-
No	800 (100)		
Gastro-esophageal reflux			
Yes	1 (0.1)		
No	799 (99.9)	21.22	0.000*
Sports			
Swimming	197 (24.6)	7.37	0.007*
Other sports	603 (75.4)		

Table 1: Socio-demographic, oral hygiene and diet related profile of the study population.

*Significant difference in distribution of participants across groups (p < 0.05).

Factors	Categories	Erosion present (%)	Erosion absent (%)	df	Chi square value	P value
Gender	Male	19 (4.9)	368 (95.1)	1	0.293	0.589
	Female	17 (4.1)	396 (95.9)			
School type	Government	18 (4.5)	382 (95.5)	1	0.000	1.000
	Private	36 (4.5)	382 (95.5)			
Socioeconomic class	Lower class	8 (2.5)	317 (97.5)	2	6.408	0.041*
	Middle class	23 (6.5)	332 (93.5)			
	Upper class	5 (4.2)	115 (95.8)			
Medical disease	Yes	1 (100)	0 (0.0)	1	0.047	0.828
	No	36 (4.5)	763 (95.5)			
Medicine consumed	Yes	0 (0.0)	1 (100.0)	1	0.047	0.828
	No	36 (4.5)	763 (95.5)			
Vitamin C supplements	Yes	-	-	-	-	-
	No	36 (4.5)	764 (95.5)			
Gastro-esophagial reflux	Yes	1 (100.0)	0 (0.0)	1	21.249	0.000*
	No	35 (4.4)	764 (95.6)			
Tooth brushing frequency	Once a day	28 (4.6)	585 (95.4)	1	0.028	0.867
	Twice or more a day	8 (4.3)	179 (95.7)			

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Tooth brushing Aid	Toothbrush Finger	36 (4.5) 0 (0.0)	760 (95.5) 4 (100.0)	1	0.189	0.663
Tooth brushing Material	Paste Others	36 (4.5) 0 (0.0)	761 (95.5) 3 (100.0)	1	0.142	0.706
Type of Dentition	Primary Mixed Permanent	17(14.2) 6 (1.1) 13(10.2)	103 (85.8) 546 (98.9) 115 (89.8)	2	50.584	0.000*

Table 2: Prevalence of dental erosion across demographic and health related variables.

Factors	Categories	Erosion present (%)	Erosion absent (%)	df	Chi square value	P value
Type of Diet	Vegetarian	15 (4.0)	361 (96.0)	1	0.430	0.512
	Mixed	21 (5.0)	403 (95.0)			
Frequency of Biscuits Consumption	Several times a day	12 (3.3)	354 (96.7)	2	2.387	0.303
	Once/several times a week	21 (5.5)	364 (94.5)			
	Seldom/Never	3 (6.1)	46 (93.9)			
Frequency of Jam Consumption	Several times a day	0 (0.0)	102(100.0)	2	7.395	0.025*
	Once/several times a week	24 (6.1)	369 (93.9)			
	Seldom/Never	12 (3.9)	293 (96.1)			
Frequency of Sweets Consumption	Several times a day	10 (4.5)	212 (95.5)	2	1.103	0.576
	Once/several times a week	20 (4.1)	467 (95.9)			
	Seldom/Never	6 (6.6)	85 (93.4)			
Type of Soft Drink consumption	Carbonated	9 (4.5)	192(95.5)	1	0.000	0.986
	Non-Carbonated	27 (4.5)	572 (95.5)			
Time of soft drink consumption	Between meals	14 (6.5)	203 (93.5)	1	2.639	0.104
	With meals	22 (3.8)	561 (96.2)			
Snacks consumption with soft drinks	Yes	8 (5.8)	131 (94.2)	2	8.168	0.017*
	No	28 (5.4)	491 (94.6)			
	Occasionally	0 (0.0)	142(100.0)			
Method of consumption	Both ways	9 (4.0)	216 (96.0)	1	21.249	0.789
	Gulping	21(5.0)	401 (95.0)			
	Straw	6 (3.9)	147 (96.1)			
Citrus fruit consumption	Several times a day	5 (2.2)	219 (95.5)	2	4.977	0.083
	Once/several times a week	28 (5.8)	454 (94.2)			
	Seldom/Never	3 (3.2)	91 (96.8)			
Sports	Swimming	2 (1.0)	0 (0.0)	1	0.047	0.007*
	Others	36 (4.5)	763 (95.5)			

Table 3: Prevalence of dental erosion across diet and lifestyle related variables.

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Surface affected	Prevalence (%)	Primary Dentition	Mixed Dentition	x^2	P value
Labial or buccal only	19 (52.8)	17 (88.9)	2(11.1)	30.74	0.000*
Lingual or palatal only	1 (2.8)	1 (100.0)	0 (0.0)	1.15	0.563
Occlusal or incisal surfaces only	0 (0.0)	-	-	-	-
Labial and incisal/occlusal	3 (8.3)	0 (0.0)	3 (100.0)	16.36	0.000*
Lingual and incisal/occlusal	0 (0.0)	-	-	-	-
Multi surfaces	1 (2.8)	1 (100.0)	0 (0.0)	1.15	0.563
Code 0: Normal enamel					
Code 1: Matte appearance of the enamel surface with no loss of contour	0 (0.0)	-	-	-	-
Code 2: Loss of enamel only (loss of surface contour)	18 (50.0)	13 (68.8)	5 (31.2)	21.84	0.000*
Code 3: Loss of enamel with exposure of dentine (dentino-enamel junction visible)	5 (13.9)	5 (100.0)	0 (0.0)	6.49	0.165
Code 4: Loss of enamel and dentine beyond dentino-enamel junction	0 (0.0)	-	-	-	-
Code 5: Loss of enamel and dentine with exposure of the pulp	0 (0.0)	-	-	-	-
Code 6: Unable to assess (e.g. tooth crowned or large restoration)	0 (0.0)	-	-	-	-
Amount of tooth surface					
Code +: More than half of the tooth surface affected	1 (2.8)	1 (100.0)	0 (0.0)	1.15	0.563
Code −: Less than half of tooth surface affected	22 (61.1)	16 (72.7)	6 (27.3)	32.04	**0.000***
Type of Dentition	n	Mean ± SD	t	df	P
Primary	17	0.29 ± 25	1.823	21	0.873
Mixed	6	0.20 ± 0.00			
Type of Dentition	n	HOSC	t	df	P
Primary	17	1.11 ± 33	0.062	21	0.855
Mixed	6	1.0 ± 0.00			

Table 4: Prevalence of O'Sullivan Index scores among participants.

*Statistically significant (p < 0.05), df- degrees of freedom, t-Student 't' test value, x^2 - Chi Square value

The mean BEWE index score was significantly higher (p = 0.006) in mixed dentition compared to permanent. Prevalence of erosive lesions was high in 13-23 sextant compared to other sextants (p = 0.00) (Table 5). Results of logistic regression indicated that the prevalence of erosion was significantly less in permanent dentition (OR = 0.08, 95% CI- 0.03-0.23, P = 0.00) and high in children engaged in sports other than swimming (OR-4.3,95% CI- 0.96-19.39, P = 0.05) (Table 6).

Discussion

The present cross-sectional survey was conducted among 800 school children in Davangere city with mean age of 9.18 ± 2.0 years to assess prevalence and severity of dental erosion and its associated risk factors. The prevalence of dental erosion among school children was low (4.5%) which may be due to less consumption of erosive food and beverages among the study subjects. Similar results were observed in few Indian studies [5,8,9], and international studies [10,11]. However contradictory findings

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Prevalence of tooth erosion across various sextants					
Sextants	Prevalence (%)	Mixed Dentition	Permanent Dentition	χ^2	P value
17-14 a	0 (0.0)	-	-	-	-
13-23 b	15 (41.7)	3 (20.0)	12(80.0)	26.03	**0.000***
24-27 c	2 (5.6)	1 (50.0)	1 (50.0)	2.52	0.283
44-47 d	3 (8.3)	2 (66.7)	1 (33.3)	6.46	0.040
33-43 e	3 (8.3)	0 (0.0)	3 (100.0)	5.79	0.055
34-37 f	3 (8.3)	2 (66.7)	1 (33.3)	6.46	0.040
Type of Dentition	N	Mean ± SD	t	df	P value
Mixed	6	0.31 ± 0.16	1.1436	17	**0.006***
Permanent	13	0.23 ± 1.13			
Type of Dentition	N	Mean HBEWE score	t value	df	P value
Mixed	6	1.16 ± 0.40	0.566	17	0.280
Permanent	13	1.07 ± 0.27			

Table 5: Prevalence of erosion (BEWE Index scores) among children with mixed and permanent dentition.

*statistically significant ($p < 0.05$), df- degrees of freedom, t-Student 't' test value, χ^2 - Chi Square value.

Factor	Category	Adjusted OR [Exp (B)]	95% confidence Interval		P value
			Lower	Upper	
Socio-economic status	Low	1			
	Middle	0.76	0.22	2.5	0.66
	High	1.34	0.45	4.0	0.59
Type of dentition	Primary	1			
	Mixed	1.08	0.46	2.5	0.85
	Permanent	0.08	0.03	0.23	0.00*
Consumption of snacks with soft drinks	Never/Rarely	1			
Consumption of Jam	Frequent	2.22	0.96	5.16	0.06
	Never/Rarely	1			
	Frequent	0.72	0.33	1.56	0.41
Sports	Others	1			
	Swimming	4.33	0.96	19.39	0.05*

Table 6: Results of logistic regression analysis.

*Statistically significant ($p < 0.05$).

were seen in few Indian studies [4,6] and few international studies where prevalence was high among children [12,13]. Perhaps the reason for these differences may be due to variations in: sample size; diagnostic criteria; indices used to measure tooth wear; lifestyles and dietary habits of the children; and the dentition assessed. Prevalence of erosion was more in deciduous dentition compared to mixed and permanent dentition in the present study. The reasons for this could be high prevalence of non-nutritive suckling habits, use of sweetened pacifies and overnight feeding pattern in them [14]. Also deciduous teeth have thinner layer of enamel and dentine,

lower degree of mineralization, higher degree of enamel porosity and different mineral content in deciduous teeth showing a higher susceptibility of deciduous enamel to erosion [12]. Similar results were observed in few studies by Frazão., *et al.* [15]. and Tao., *et al.* [16]. However, prevalence of dental erosion in deciduous dentition was low in study done by Babu NY., *et al.* [6]. Prevalence of erosion was more in maxillary anterior teeth compared to posterior teeth and mandibular teeth. Similar result was observed in study done by Chrysanthakopoulos NA., *et al.* [17]. Maxillary incisors are more prone to dental erosion than mandibular incisors because

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mandibular incisors are more protected by saliva and the tongue during the ingestion of acidic foods and beverages. The positioning of soft tissues can also exert an influence on the erosive process as eroded enamel can undergo further wear when coming into contact with soft tissues [8]. However contradictory findings were observed in few studies where, erosion was more in posterior teeth compared to anterior teeth [5.8]. Contradictory finding may be because of the different age groups of study population in these studies. Loss of enamel was more prevalent in the present study depicting less severity of erosive lesions. This could be due to the less consumption of erosive juices and beverages among the south Indian population Similar results were observed in few Indian studies [5,8]. However contradictory results were observed in few studies where severity of erosive lesions was more involving more tooth surface and dentine surface [18]. This was attributed to increased consumption of carbonated drinks especially during night hours by children which was supported by parents [18]. Monthly family income, regurgitation, jam consumption, snacks with soft drinks consumption, sports and type of dentition variables were significantly associated with erosion. Similar results were seen in few studies where monthly family income, type of dentition, jam consumption, regurgitation, consumption of snacks with soft drinks, and sports were significantly associated with dental erosion [19,20]. However few studies demonstrated no correlation between monthly family income, regurgitation, jam consumption, snacks with soft drinks consumption, and sports [19,20]. In the present study, higher prevalence of dental erosion was observed among the children who belonged to the middle socioeconomic status. This may be due to consumption of acidic commercial fruit juices by children which are fancily marketed and sold at cost which is affordable and easily accessible by children and parents of middle income groups. Moreover, the parents/caregivers of such school children may have less information on the harmful effects of acidic food and beverages than those with a more privileged socioeconomic status. Similar results were found in the few studies in which prevalence of dental erosion was higher in middle socioeconomic status children [5,19]. However, contradictory findings were observed in few studies [16]. Dental erosion prevalence in the present study was higher in children who consumed snacks with soft drinks and who consumed jam frequently and who were suffering from gastroesophagial reflux According to Fiorentino., et al, every time a snack is ingested with a soft drink or carbonated drinks, additional gastric acid secretion is produced which causes gastroesophagial reflux disease (GERD) which in turn leads to dental erosion [21].

In the present study there was a higher prevalence of dental erosion in children who played sports other than swimming. The reason for this could be, high intake of sports drinks during exercise, coupled with xerostomia from dehydration, which leads to erosive damage to teeth. Similar results were found by Kumar., et al. [5].

To the best of author's knowledge, this was the first study to find and compare prevalence of dental erosion in primary, mixed and permanent dentition. This study is first of its kind to include both the indices i.e. O'Sullivan and BEWE to compare erosion in primary and mixed and mixed and permanent dentition respectively. The dental erosion index proposed by O'Sullivan was used to record the distribution, severity, and amount of affected teeth. This index is especially designed for epidemiologic surveys and for diagnosis of erosion in children with primary teeth to determine treatment options [10]. Basic Erosive Wear Examination (BEWE) is commonly used to assess dental erosion in permanent teeth in children. Studies have reported acceptable reliability and validity measures. The BEWE system was developed in 2007 following an international workshop on erosion indices [11]. Children with dental erosion were very less compared to those who had no erosion. Hence comparison of risk factors of erosion between erosion and non-erosion groups may not be valid. Hence matched analytical longitudinal studies involving large sample of children would give better insights in understanding the associated risk factors of dental erosion. Various awareness programs about prevention of dental erosion needs to be designed and conducted involving children, caretakers and teachers in order to bring down the prevalence. Various policies such as ban of soft drinks sales near schools should be promoted. Advertisements on carbonated beverages should be limited on kids TV Channels. Mothers should be educated regarding diet planning of their children towards prevention of dental erosion. Chapters in the school curriculum of children can be designed to educate the children regarding the harmful effects of erosion and its prevention. To protect the integrity of the dental tissue and prevent the effects of dental erosion on children's oral health, remineralizing procedures and minimally invasive reconstruction should be used when evidence of dental erosion is found.

Conclusion

Prevalence of dental erosion in Davanagere city was low (4.5%) among school children aged 6-12 years. This study provides a strong baseline data which might help identify the existing risk factors of dental erosion in the particular region and curtail those factors and design preventive programs to further halt the rising prevalence of dental erosion.

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