

## Dental erosion among 12-14 year old school children in Khartoum: A pilot study

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**Objectives:** To investigate dental erosion among 12-14 year old Sudanese school children and evaluate the associated risk factors. **Basic Research Design:** Cross sectional survey in secondary schools in Khartoum city, Sudan. **Method and Participants:** A sample of 157 school children was obtained from both private and public schools. Erosion on the labial and palatal surfaces of maxillary incisors was measured by criterion based on the Smith and Knight Tooth Wear Index. Dietary intake and other related factors were assessed using a questionnaire. **Results:** The overall erosion prevalence in this group was 66.9%, of which 45.2% was mild and 21.7% was moderate erosion. A strong association was found between erosion and private schooling (higher socioeconomic groups), carbonated drinks, herbal hibiscus drink and traditional acidic food consumption. **Conclusion:** There was a high prevalence of dental erosion among Sudanese school children which was mild to moderate in severity and was strongly associated with acidic dietary intake

**Key words:** Baobab, carbonated drinks, dental erosion, Hibiscus, Tamarind

### Introduction

Dental erosion is a pathological process, which is chronic in nature and results from chemical etching of tooth surfaces by an acid and/or chelating agent without any bacterial involvement (Ten cate and Imfeld, 1996).

Dental erosion has emerged as an oral health problem among children and young adults and recently gained considerable interest. Numerous epidemiological studies in developed countries have investigated the prevalence of dental erosion among children (Dugmore and Rock, 2004a; Al-Dlaigan *et al.*, 2001a; O'Brien 1994). Epidemiological studies from developing countries on the prevalence of dental erosion are limited and from available data a high prevalence has been reported (Al-Majed *et al.*, 2002; Al-Malik *et al.* 2002).

There is increasing evidence that the aetiology of dental erosion is multifactorial. Several factors are involved including, saliva flow and composition, intrinsic acids from gastro-oesophageal reflux and extrinsic dietary acids. The proportional contribution of these factors to the overall development of dental erosion is uncertain (Bartlett *et al.*, 1996). It is also uncertain if these factors' proportional contribution would vary in different regions.

Many investigators have reported a strong and significant association between the presence of dental erosion and the increased consumption of acidic drinks (Al-Dlaigan *et al.*, 2001b; Milosevic *et al.*, 1997), while others linked erosion to socio-economic status and culture (Dugmore and Rock, 2004b; Harding *et al.*, 2003; Van Rijkom *et al.*, 2002; Al-Dlaigan *et al.*, 2001a). In view

of the high prevalence of erosion reported in developing countries and in the absence of data on dental erosion among Sudanese school children this pilot study was designed to investigate the prevalence of dental erosion in Khartoum city and explore the associated risk factors.

### Subjects and Methods

The study area was Khartoum the capital city of Sudan. The population in Khartoum is derived from different ethnic and socio-economic groups that comprise a true representation of the population in this largest African country.

Information obtained from the Ministry of Education in Khartoum in 2006 indicated that there are 271 boys and 399 girls schools in the Khartoum state. The total number of boys in the 1<sup>st</sup> year in secondary schools is 20,170 and the number of girls is 22,297. Four schools, two boys' and two girls', were selected for this study. Of these two were private schools from Khartoum East (high socioeconomic area) and two public schools from the low socioeconomic area of south west Khartoum.

Ethical approval was obtained from the Faculty of Dentistry Ethics Committee in Khartoum University following a protocol submission and permission for examination of the children was obtained from each schools.

Children in the first year class in each school were invited to participate to make up convenient sample for the pilot study. The exclusion criteria were children who were not in the age of 12-14 years old or those with significant medical history. A total of 157 children agreed to participate in the study, 82 children from the

public schools and 75 children from the private schools with a 98.6% response rate.

Children were examined in their schools lying in a semi reclined chair with a headrest. The examination was carried out under ordinary daylight, since illumination was sufficient for clear vision and examination. Teeth were dried with cotton rolls prior to examination. Sterilised mouth mirrors were used to visually inspect teeth for the presence of dental erosion on the palatal and labial surfaces of maxillary incisors. Dental erosion in this age group is likely to be detected on the labial and palatal surfaces of maxillary anterior teeth, however there is always a possibility of the presence of components of abrasion or attrition that would make it difficult to have a definitive diagnosis (Millward 1994a). Harding *et al.*, 2003 and O'Brien 1994 also limited their investigations to these surfaces. The surfaces were scored for dental erosion according to criteria based on the Tooth Wear Index of Smith and Knight. This criterion has been used in UK 1993 National Survey of Child Dental Health and subsequently used by other investigators (Harding *et al.*, 2003; Al-Majed *et al.*, 2002) as follows:

- 0 Normal, no loss of enamel surface characteristics
- 1 Enamel only-loss of enamel surface characteristics (mild erosion)
- 2 Enamel and dentine-loss of enamel exposing dentine (moderate erosion)
- 3 Enamel, dentine and pulp-loss of enamel and dentine exposing the pulp (severe erosion)
- 9 Assessment couldn't be made- tooth missed or crowned or has large restoration

Examination of all the children was carried out by the first author who has been trained in using this index. Reproducibility was evaluated by re-examining 28 children and kappa value of 0.80 was obtained indicating a good level of intra examiner agreement.

#### *The questionnaire*

A questionnaire was designed to include and evaluate the known associated risk factors for dental erosion. Data was collected on the oral hygiene habits and history of vomiting or symptoms of gastro-oesophageal reflux disease. Data to evaluate dietary habits were also obtained by including in the questionnaire the commonly consumed acidic food and drinks (citrus fruit juice, carbonated drinks and herbal drinks particularly hibiscus, citrus fruit, yoghurt, cheese and the traditional food namely Baobab and Tamarind). In addition the questionnaire was designed to determine the amount and frequency of consumption of food and drinks which was categorised as follows:

No consumption at all

Low consumption: 1- 7 times per week.

Medium consumption: 8-21 times per week.

High consumption: more than 21 times per week.

The validity of the questionnaire was evaluated previously in a pilot sample of children prior to the current data collection.

The data was analysed using SPSS version 11. The relationship between the prevalence of dental erosion and the associated risk factor variables were assessed by Chi-Square test and the significant variables were

further analyses using logistic and ordinal regression analysis. Statistical significance was accepted at the 95% confidence interval level,  $p < 0.05$

## **Results**

Of the hundred and fifty-seven school children examined 56.7% were female and 43.3% were male. 52.2% were in public schools and 47.8% were in private schools.

Erosion was generally evident in 66.9% of the children; of these 45.2% had evidence of mild dental erosion and 21.7% had moderate dental erosion with no reported severe erosion. In addition dental erosion was particularly higher on the palatal than the labial surfaces of maxillary incisors (Table 1).

Analysis of the data from the questionnaire showed variable consumption rate of acidic drinks and food that was generally low to medium. The consumption of carbonated drinks, hibiscus and traditional food on the other hand was relatively higher (Table 2 and 3). The relationship between the prevalence of dental erosion and the associated risk factor variables was assessed using the Chi-Square Test. Logistic regression analyses were then performed for each statistically significant erosion related questionnaire variable as an independent variable and the presence or absence of erosion as a dependent variable. Chi-Square test revealed significant association between prevalence of erosion and the variables school type and consumption of carbonated and traditional food whereas hibiscus had a borderline significance (Table 2). When logistic regression analysis was performed, school type (odds ratio 2.3,  $p < 0.000$ ), consumption of carbonated drinks (odds ratio 3.8,  $p < 0.002$ ) and traditional food (odds ratio 2.7,  $p < 0.006$ ) were the only variables found to have statistically significant association with erosion, (Table 3). To further investigate the relationship of these risk factors to the severity of erosion, Chi-Square test and Ordinal regression were performed on those variables and the degree of erosion. A significant association was found between the degree of erosion and, school type ( $p < 0.004$ , CI 0.16, 0.8), consumption of carbonated drinks ( $p < 0.000$  CI 0.5, 1.6), traditional food ( $p < 0.002$  CI 0.2, 1.3 and hibiscus ( $p < 0.02$  CI 8.5, 1.2) (Table 4 and 5)

## **Discussion**

This pilot study was the first to investigate the prevalence of dental erosion among Sudanese school children. The main limitation of this study is that the sample was selected for the purpose of a pilot study and hence considered a convenience sample and may not be a true representation of the whole Khartoum population. The finding that 66.9% of the children had evidence of dental erosion is higher than that reported by investigators in the United Kingdom (Dugmore and Rock 2004a, Al-Dlaigan *et al.*, 2001a; O'Brien 1994) but less than that reported in Saudi Arabian school children of the same age group (Al Majed *et al.*, 2002). However, the finding that 21.7% of children had evidence of erosion exposing the dentine is in agreement with that reported by Al Majed *et al.*, 2002. The report of no difference in erosion prevalence between male and female subjects of this study was not in agreement with the findings of

**Table 1.** Prevalence of dental erosion on the Palatal and labial surfaces of maxillary incisors

Tooth	Prevalence of erosion					
	no erosion		mild erosion		moderate erosion	
	n (%)		n (%)		n (%)	
	P	L	P	L	P	L
Right lateral	49.0	77.7	35.0	20.4	15.9	1.9
Right central	46.5	77.1	38.2	20.4	15.3	2.5
Left central	49.7	75.8	35.7	22.9	14.6	1.3
Left lateral	45.9	77.1	37.6	20.4	15.9	2.5

P: Palatal  
L: labial

**Table 2.** Chi-Square test for prevalence of erosion and associated risk factors in the study population

Variable	Erosion			Chi-square	p value
	Yes	No	Total		
<i>School type</i>					
Private	65	10	75		
Public	69	43	132		
Total	104	53	157	26.7	.000
<i>Carbonated drinks</i>					
No consumption	5	4	9		
Low	43	47	90		
Medium	42	2	44		
High	14	0	14		
Total	104	53	157	38.1	.000
<i>Traditional food</i>					
No consumption	18	16	34		
Low	63	35	98		
Medium	20	2	22		
High	3	0	3		
Total	104	53	157	10.3	0.01
<i>Hibiscus</i>					
No consumption	25	17	42		
Low	66	36	102		
Medium	11	0	11		
High	2	0	2		
Total	104	53	157	7.5	0.05

**Table 3.** Results of logistic regression analysis for significant factors affecting prevalence of erosion in study population

	Odds ratio	p value	95% CI
			Lower /Upper
School type	2.3	0.000	1.4, 3.6
Hibiscus drink	1.3	0.3	0.6, 3.02
Carbonated drink	3.8	0.002	1.6, 8.9
Traditional food	2.7	0.006	1.3, 5.8

**Table 4.** Chi-Square test for degree of erosion and associated risk factors in the study population

Variable	Erosion				Chi-square	p value
	No	Mild	Moderate	Total		
<i>School type</i>						
Private	10	42	23	75	27	.000
Public	43	27	12	82		
Total	53	69	35	157		
<i>Carbonated drinks</i>						
No consumption	4	4	1	9	51.5	.000
Low	47	36	7	90		
Medium	2	23	19	44		
High	0	6	8	14		
Total	53	69	35	157		
<i>Traditional food</i>						
No consumption	16	13	5	34	13.4	0.03
Low	35	43	20	98		
Medium	2	12	8	22		
High	0	1	2	3		
Total	53	69	35	157		
<i>Hibiscus</i>						
No consumption	17	9	6	42	26.5	0.000
Low	36	47	19	102		
Medium	0	3	8	11		
High	0	0	2	2		
Total	53	69	35	157		

**Table 5.** Results of ordinal regression analysis for significant factors affecting degree of erosion in the study population

	p value	95% CI
		Lower /Upper
School type	0.004	0.16, 0.89
Hibiscus drink	0.02	8.5, 1.2
Carbonated drink	0.000	0.5, 1.6
Traditional food	0.002	0.2, 1.3

other investigators who reported more erosion in males (Dugmore and Rock 2004a, Al-Dlaigan *et al.*, 2001a). However similar findings to the current study were reported by Ogunyinka *et al* 2001 who found no gender difference in tooth wear prevalence among Nigerian children. Although there is an agreement on this issue between the current study and that of Ogunyinka *et al* 2001 the sample size in both studies is a limitation in reaching a definitive conclusion. Further investigations with larger samples would be beneficial.

In this study it was found difficult to classify the children using conventional socio-economic status measures. Indeed AL Malik *et al.*, 2002 found difficulties in using conventional measures of socio-economic status in Saudi Arabia which would be a similar situation to that in Sudan. The school type was therefore used as a surrogate measure of socio-economic background where

children in private school were considered to be in a higher socio-economic status than children in public schools in deprived areas. The finding of the present study that a higher degree of erosion was found among private school children who are assumed to be in a higher socio-economic status is contrary to that reported by other investigators (Harding *et al.*, 2003; Van Rijkom *et al.*, 2002; Al-Dlaigan *et al.*, 2001a), where erosion was considered to be a problem of socially deprived groups. Al Malik *et al* did not find association between erosion and social class and attributed that in part to difficulties in using conventional measures of socio-economic status. (Al-Malik *et al* 2002) Our study concurs with the finding of Millward *et al.*, 1994b that more erosion was evident among children from high socio-economic background. These factors in addition to effect of culture (Dugmore and Rock, 2004b) may explain the findings in the present study.

There is overwhelming evidence that dental erosion is associated with excessive intake of acidic food and drinks. The findings in this study, that erosion is more prevalent among children who consume excessive amounts of acidic food and drinks is in agreement with that reported by other investigators (Dugmore and Rock, 2004b; Harding *et al* 2003; Al-Dlaigan *et al.*, 2001b). Carbonated drinks in particular were found to be consumed by 94.3% of the children and a strong association between erosion and cola type drinks was evident in this study, supporting the previous evidence of Johansson *et al.*, 1997 and Milosevic *et al.*, 1997. The interesting and important finding

in this study was the association between the degree of erosion and consumption of hibiscus drink. Hibiscus is one of the traditional drinks that are consumed by the Sudanese population. Phelan and Rees 2003 have previously described the erosive potential of hibiscus as herbal tea and the result of this pilot study is in agreement with their findings. The traditional foods investigated in this study were mainly Tamarinds and Baobab. These are Vitamin C rich dry citrus fruits that are produced locally and consumed by children as snacks, usually sucked and left for long periods of time in the mouth to extract the acidic juice from them. Being citrus fruit, they are likely to have a strong erosive potential as indicated by the finding of this study, however, further investigation of their erosive potential is needed.

The frequency of tooth brushing has been implicated in the aetiology dental erosion in previous studies (Jaeggi 1999; Lussi and Schaffner 2000). The majority of the children in the present study brush their teeth once a day and not necessarily immediately after intake of erosive food or drink. This factor does not seem to have an association with erosion in this study.

No association was found between gastric upsets and erosion in this study since this factor is more likely to be relevant in older population group (O'Sullivan *et al.*, 1998). The high prevalence of dental erosion on the palatal surfaces of maxillary teeth in this study despite the absence of evidence of gastro-oesophageal reflux disease might be attributable to suction habits of consumption of traditional food (Tamarinds and Baobab). Further studies should investigate this association.

### Conclusion

Within the limitations of this pilot study it is suggested that dental erosion could constitute a potential oral health problem among Sudanese school children and that further studies utilizing larger samples and different age groups is needed to fully clarify the magnitude of the problem and address its associated risk factors.

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