

Huew Rasmia<sup>1</sup>, Fowziya Ali<sup>1</sup>, Khadija Herwis<sup>1</sup>, Fathiya Mohamed<sup>2</sup>, Ahmed Ali Musrati<sup>1\*</sup>

<sup>1</sup>Department of Child Dental Health, Faculty of Dentistry, University of Benghazi, Benghazi, Libya

<sup>2</sup>Department of Orthodontics, Faculty of Dentistry, University of Benghazi, Benghazi, Libya

Dates: Received: 26 July, 2016; Accepted: 23 August, 2016; Published: 24 August, 2016

\*Corresponding author: Ahmed Ali Musrati; BDS, MSc, PhD, Department of Child Dental Health, Faculty of Dentistry, University of Benghazi, Benghazi, Libya. Tel. E-mail: ahsamu@utu.li

www.peertechz.com

ISSN: 2455-4634

Keywords: Dental erosion; Children; Gender; Libya

## Research Article

# Prevalence of Dental Erosion in a Group of Schoolchildren from Benghazi, Libya

### Abstract

**Aims:** Despite the growing concern that the prevalence of dental erosion has increased amongst children, the data on its prevalence is still scarce in Libya. Therefore, this study aimed to measure the prevalence of dental erosion and examine gender differences in relation to its prevalence in a group of schoolchildren in Benghazi, Libya.

**Methods:** A cross-sectional observational study was conducted in Benghazi. A random sample of 12 year-old schoolchildren (n=180; 92 boys and 88 girls) attending elementary schools in Benghazi were dentally screened for erosion using UK National Diet and Nutrition Survey (NDNS Criteria).

**Results:** The prevalence of dental erosion was 36.9%. A higher experience of erosion was observed amongst girls (40.9%) than boys (37%), this difference was not statistically significant (p=0.647).

**Conclusions:** In the present study, the relatively high proportion of children in Benghazi, Libya affected by dental erosion emphasizes the importance of preventive measures needed to control the erosive process, before more invasive treatments become a necessity to restore eroded teeth.

## Introduction

Dental erosion appears to be a relatively recent condition. The interest in studying dental erosion has arisen in recent decades, especially following the decline in prevalence of dental caries in children from developed countries [1-4]. Dental erosion has been defined as a progressive irreversible loss of dental hard tissues by a chemical process, not involving bacteria [5-7]. The typical clinical features of dental erosion in anterior teeth include silky-glazed appearance (absence of perikymata) of intact enamel along the gingival margin; while posterior teeth are manifested with cupping and grooving on occlusal surfaces [8]. The fact that some individuals are more prone to develop dental erosion reflects the multifactorial nature whereby interaction of chemical, biological and behavioural factors explains such variation [9,10]. Erosion is most often found in association with other forms of tooth wear such as abrasion and attrition [11]. The majority of tooth wear in childhood is due to dental erosion [12-16]. Adequate preventive measures can be implemented only when the risk factors are known [17].

Dental erosion is caused mainly by intrinsic or extrinsic acids; intrinsic acids from gastro-oesophageal reflux or frequent vomiting, while the source of extrinsic acids may be frequent consumption of acidic foods and beverages, particularly fruits and fruit juices, soft drinks, herbal tea, wines and vinegar and frequent swimming in heavily chlorinated water [1,11,13,18-23].

Poor salivary flow associated with insufficient buffering capacity exacerbate dental erosion [24]. Dental erosion in children, which is caused mainly by frequent intake of acidic food and drinks, is a common condition with early damage to the teeth potentially affecting oral health for an entire lifetime and requiring extensive, difficult and complicated treatment [25]. Therefore, early diagnosis and

prevention of erosion in children and adults is important. The decline in caries has made dental erosion become increasingly recognized as a public health concern amongst children and adolescents [26].

Several epidemiological studies showed increasing interest in the study of tooth wear and more particularly dental erosion. Several studies offered a better understanding of tooth wear and dental erosion and their potential risk factors. These published studies include in vitro and in situ studies [27-33], case-control studies [34-37], cross-sectional studies [38-46] and longitudinal studies [47-49]. The main aims of these studies were assessment of the prevalence of dental erosion or tooth wear and recognition of possible factors associated with its development and progression.

Most dental erosion data are derived from European studies; only a few epidemiological studies of dental erosion prevalence have been undertaken in developing countries [23,43, 50-53].

There are a few published epidemiological studies relating to the prevalence of dental erosion in Libya. The aims of this study were to determine the prevalence and severity of dental erosion and to examine gender differences in relation to the prevalence and severity of dental erosion amongst 12 year-old schoolchildren in Benghazi, Libya. Early diagnosis and prevention of erosion in children and adults is important not only to control erosion and prevent further complications, but also to minimize the costs of the complex extensive treatment.

## Subjects and Methods

### Ethical approval and permissions from local authorities

Ethical clearance and permissions to conduct the study in Benghazi was obtained from the local authorities, Education Ministry,



Health Ministry, schools and consents obtained from parents and children.

### Obtaining the sample

A cross-sectional observational study was conducted in Benghazi. There is no governmental classification of areas based upon socioeconomic information in Libya. Therefore, a cluster sampling within the schools was used for school sampling. These children were studying at the sixth grade in 36 elementary co-educational public schools drawn from the 15 different districts with different socioeconomic groups and cultures. First, a random sample of schools was selected; at least one school from each district, and at least two schools from districts with 6 or more schools. Then a random selection of boys and girls from each elementary school was made. From the children with parental written consent, a sample was randomly selected. Using a list of randomly generated numbers between 1 and 99 a selection of the children was made using columns, for example starting with column 2 to sample 7 children from within a school. Seven children were randomly selected from each of 36 randomly selected schools to achieve a sample of 252 subjects. The target sample size for completion was 175 which would provide 95% power to detect a correlation coefficient of 0.3 assuming a Type 1 error rate of 5%. The target for recruitment was set at 252 to allow for attrition.

### Dental examination

Dental erosion was determined according to the index of the oral health component of the UK National Diet and Nutrition Survey (NDNS) [40] (Table 1). The labial and palatal surfaces of all permanent maxillary incisors and the occlusal surfaces of the first permanent molars were assessed for the depth and area of erosive loss, recorded on the oral health assessment sheets. The screened teeth surfaces were examined for a range of appearances from loss of surface enamel to exposure of dentine or pulp.

Depth of dental erosion on a surface was scored as code 1 if erosion was seen in enamel only, code 2 if erosion was seen in enamel and dentine, code 3 if involving enamel, dentine and pulp. The area of dental erosion on a surface was scored as code 1 if dental erosion affected less than one third surface, code 2 if a affected up to two thirds of the surface and code 3 if it was more than two thirds. In cases where there was doubt over the assessment of a surface, the lower score was assigned [40].

### Reproducibility of the study

For the purpose of reproducibility, in each school, 10% of the dentally examined children was randomly re-examined on the same

day as the dental examination to determine the reproducibility of the application of diagnostic criteria and to provide data for intra-examiner reproducibility. The results of the dental examination were analysed for reproducibility by Cohen's Kappa and the following thresholds were considered; score 0 (total disagreement), score 0.4-0.6 (moderate agreement), score 0.6-0.8 (substantial agreement), score >0.8 (good agreement) and score =1 (perfect agreement) [54].

### Statistical analysis

Dental erosion data were copied into a database designed within the Statistical Package for Social Sciences-SPSS 15.0 for Windows. A second database, with data from subjects who had been examined in duplicate, was developed to measure the level of intra-examiner agreement in assessing dental erosion. The prevalence of erosion was calculated as the number and proportion of subjects affected. Dental erosion for area and for depth was cross tabulated with gender.

### Results

#### Study sample

Two hundred and fifty two children were randomly selected in thirty six randomly selected public schools: seven children per school. Written consents were obtained from one hundred and eighty subjects (71%) who attended the clinical dental examination. There were 92 boys (51.1 %) and 88 girls (48.9 %). The mean age of the 180 children was 12.3 years (SD  $\pm$  0.29).

#### Dental examinations

Dental examinations were conducted at schools. Ten per cent of the total sample size was randomly selected and dentally examined for a second time during each dental examination session to assess the reproducibility of this study. The dental examination was undertaken in any available space, such as class rooms, libraries, and laboratories. The dental examination was conducted under artificial light, with additional lighting via a headlamp which was used throughout the dental examination as the diagnostic source of light. The subjects were seated in an ordinary chair, in front of the examiner. For the dental examination the examiner used pre-packed sterilised oral examination kits which contained, a plain mouth mirror and a probe to help detect dental caries by removing food debris.

Dental erosion was recorded by depth and area and a subject number was used throughout the study keeping the name and subject number separate. The teeth surfaces were examined for loss of surface enamel and exposure of dentine or pulp. The date of examination was recorded. The date of birth was recorded from school files.

#### Prevalence of dental erosion

Of the 180 subjects, 70 (38.9%) had experience of dental erosion. There were 110 subjects (61.1%) had no evidence of dental erosion. A higher experience of erosion was observed amongst girls than boys, but this difference was not statistically significant (Fisher's exact test;  $p=0.647$ ) (Table 2).

#### Reproducibility of the study

The levels of intra-examiner agreement in the assessment of dental erosion, as measured by Cohen's Kappa statistic [54], for code

**Table 1:** Criteria used to assess dental erosion [40].

Code	Depth	Area of surface affected
0	Normal	Normal
1	Enamel only	Less than one third of surface involved
2	Enamel and dentine	One third up to two thirds of surface involved
3	Enamel, dentine and pulp	Two thirds or more of surface involved
9	Assessment cannot be made	Assessment cannot be made



**Table 2: Significance of association (P) between the number (N) and proportion (%) of subjects with or without experience of dental erosion in the sub-sample and gender.**

Gender	Girls			Boys			Both		
	Yes	No	Total	Yes	No	Total	Yes	No	Total
No. of subjects	36	52	88	34	58	92	70	110	180
%	40.9	59.1	100.0	37.0	63.0	100.0	38.9	61.1	100.0

Fisher's exact test;  $p = 0.647$  OR= 1.18 (95% CI 0.65, 2.15).

1 by depth (erosion into enamel only) was 89% for the incisors and 77% for molars. This indicated a good level of agreement for incisors and substantial agreement for molars.

## Discussion

This study was conducted in Benghazi, the second largest city in Libya after the capital, Tripoli. The study sample, which consisted of 180 schoolchildren, was collected from 36 public elementary schools distributed in 15 districts. More than 88% of the whole Libyan population live in cities [55]. This study aimed to determine the prevalence and severity of dental erosion in children and investigate the gender differences in relation to dental erosion.

Even though the study concept in Benghazi was received with encouragement and support from the authorities, schools and parents, there were some difficulties and limitations. Because the dental examinations took place in schools some challenges were encountered such as interruption of dental examinations due to school activities or only small space being available within the school for dental examination, or rooms with poor lighting conditions, which necessitated the use of the headlamp. However, co-operation of the School teachers, the staff and subjects helped to finish the dental examination smoothly.

The erosion index and criteria used in the present study had been validated in National Surveys in the UK [19,40]. This index was selected because it is simple, easy to use and can evaluate severity and affected tooth surface area. It had been specially designed to assess erosive tooth surface loss in the children and has been used in large epidemiological studies. The age of 12 years was selected because of the exposure of the index teeth, which should have been fully erupted, to dental erosive factors for about six years. In addition, at this age group comparison with results from other studies is made possible.

All subjects were examined clinically by the one expert examiner (RH). A good level of intra-examiner agreement was achieved using the Cohen's Kappa statistic [54], for dental erosion into enamel only (score 1 for depth). It is difficult to detect dental erosion at an early stage but, the most important feature for dental professionals to diagnose dental erosion is change in the clinical appearance of the tooth surfaces especially in early stage of erosive tooth wear [17].

A good level of intra-examiner agreement was achieved using the Cohen's Kappa statistic [54], for dental erosion into enamel only (score 1 for depth). This has been shown to be the most difficult erosion score to diagnose [19,39], and it was re-assuring to find that the reproducibility was similar to that found in previous studies assessing dental erosion [43,50,53,56-58].

The results of the present study showed that the mouth prevalence of dental erosion was 38.9%. This figure was lower than the value found in the UK NDNS for 11-14 year-olds, in which 52% of the children examined were affected [40]. On the other hand, the prevalence in this study was higher than 33% for 12 year-olds [19], found in the 2003 UK CDH Survey. When comparing the present findings with other studies which have used the same index and criteria, the prevalence of erosion in this study was found to be higher than the prevalence of erosion found in 13-14 year-old Brazilian children (34%) [43]. Conversely the prevalence found in this study was lower than the 60% found amongst 12 year-olds in the UK [56]. It was also much less than the prevalence of 95% recorded in 862 12-14 year-old Saudi Arabian boys [50]. Both these figures were higher than the findings of the present study; the reason might be due to the high consumption of acidic drinks by Saudi Arabian subjects which was reported by Saudi Arabian studies [23,50], and 27% of 12-14 year-old Saudi Arabia boys consumed acidic drinks at night reported by Al-Majed et al. [50]. The UK National Diet and Nutrition Survey amongst 11-14 year-olds reported a mean daily intake of 240 grams of carbonated drinks [40]. In contrast with other studies which used different methodology and indices, the prevalence of dental erosion in the present study was lower than the prevalence of 57% found for 11-14 year-olds in London using the Smith and Knight tooth wear index [59] and lower than the 66.9% found among 12-14 year-old Sudanese children also using Smith and Knight tooth wear index [51], but it was higher than the one reported in a study in San Antonio, US in 12-17 year-olds, in which 5.5% of the children affected by dental erosion [60], an Australian study in 5-14 year-olds using a modified erosion index, in which 25% of the subjects with permanent teeth were found to have erosion [61], the 26% of 12 year-old Brazilian children using O'Sullivan index [62], the 37% of 11-13 year-old children in the UK and 41% of 11-13 year-old children in US [63], the 37% amongst 13 year-old children in United States using the modified Smith and Knight Tooth Index [26] and higher than the 38.1% amongst 12 year-old children in Iran using O'Sullivan index [64].

## Dental erosion and gender

A higher experience of erosion was observed amongst girls (40.9%) than boys (37%) in the present study. This difference was not statistically significant. Similar results, with girls more affected by erosion than boys, were reported in a Cuban study on 12 year-olds [65]. Other studies have reported no significant gender differences [40,53,58,59,63,66]. In contrast, several studies have reported that boys had more experience of dental erosion than girls [15,40,43,67-69]. The differences in the prevalence of dental erosion between boys and girls in the present study may be explained by a difference of exposure to risk factors in this population.



## Conclusions

Of 180 subjects, 70 (38.9%) had evidence of dental erosion, which was over one third of the subjects and higher amongst girls than boys. The null hypothesis of this study was accepted; there is no difference in the prevalence and severity of dental erosion in 12 year-old children in Benghazi, Libya children compared to children from other countries.

Epidemiological studies using a unified approach to determine dental erosion are needed in different regions in Libya. These will provide a clearer picture regarding the prevalence of dental erosion and to determine if dental erosion a cause of concern in terms of public oral health in Libya.

## Acknowledgements

The authors would like to thank the Ministry of Education and Ministry of Health. The authors also thank all the schoolchildren, parents, and schools staff in Benghazi for their cooperation with the study.

## References

- Nunn J, et al. (2001) A longitudinal study of dental erosion in adolescent girls. *Caries Research* 35: 296.
- Szöke J, Petersen PE (2000) Evidence for dental caries decline among children in an East European country (Hungary). *Community Dent Oral Epidemiol* 28: 155-160.
- Dugmore CR, Rock WP (2003) Awareness of tooth erosion in 12 year-old children and primary care dental practitioners. *Community Dent Health* 20: 223-227.
- Szöke J, Petersen PE (2000) Evidence for dental caries decline among children in an East European country (Hungary). *Community Dent Oral Epidemiol* 28: 155-160.
- Nunn J, Shaw L, Smith A (1996) Tooth wear-dental erosion. *Br Dent J* 180: 349-352.
- Imfeld T (1996) Prevention of progression of dental erosion by professional and individual prophylactic measures. *Eur J Oral Sci* 104: 215-220.
- Linnett V, Seow WK (2001) Dental erosion in children: a literature review. *Pediatric Dentistry* 23: 37-43.
- Lussi A, Hellwig E, Zero D, Jaeggi T (2006) Erosive tooth wear: diagnosis, risk factors and prevention. *Am J Dent* 19: 319-325.
- Lussi A, Jaeggi T (2008) Erosion-diagnosis and risk factors. *Clin Oral Investig* 12: 5-13.
- Dugmore CR1, Rock WP (2004) A multifactorial analysis of factors associated with dental erosion. *Br Dent J* 196: 283-286.
- Bartlett D (2009) Etiology and prevention of acid erosion. *Compendium of continuing education in dentistry* (Jamesburg, NJ: 1995) 30: 616.
- Smith BG, Knight JK (1984) A comparison of patterns of tooth wear with aetiological factors. *Br Dent J* 157: 16-19.
- Millward A, Shaw L, Smith A (1994) Dental erosion in four-year-old children from differing socioeconomic backgrounds. *ASDC J Dent Child* 61: 263-266.
- Milosevic A (1998) Toothwear: aetiology and presentation. *Dent Update* 25: 6-11.
- Milosevic A, Young PJ, Lennon MA (1994) The prevalence of tooth wear in 14 year-old school children in Liverpool. *Community Dent Health* 11: 83-86.
- Chadwick BL, White DA, Morris AJ, Evans D, Pitts NB (2006) Non-carious tooth conditions in children in the UK, 2003. *Br Dent J* 200: 379-384.
- Lussi A, Schaffner M, Jaeggi T (2007) Dental erosion: diagnosis and prevention in children and adults. *International Dental Journal* 57: 385-388.
- al-Dlaigan YH, Shaw L, Smith AJ (2001) Vegetarian children and dental erosion. *Int J Paediatr Dent* 11: 184-192.
- Chadwick BL, White DA, Morris AJ, Evans D, Pitts NB (2006) Non - carious dental conditions. *Children's Dental Health in the United Kingdom, 2003*. *Br Dent J* 200: 379-384.
- Milosevic A, Bardsley PF, Taylor S (2004) Epidemiological studies of tooth wear and dental erosion in 14-year old children in North West England. Part 2: The association of diet and habits. *Br Dent J* 197: 479-483.
- Shaw L, Smith AJ (1999) Dental erosion-the problem and some practical solutions. *Br Dent J* 186: 115-118.
- Al-Dlaigan YH, Shaw L, Smith A (2001) Dental erosion in a group of British 14 year-old school children. Part II: influence of dietary intake. *Br Dent J* 190: 258-261.
- Johansson AK, Johansson A, Birkhed D, Omar R, Baghdadi S, et al. (1996) Dental erosion, soft-drink intake, and oral health in young Saudi men, and the development of a system for assessing erosive anterior tooth wear. *Acta Odontol Scand* 54: 369-378.
- Moynihan P, Petersen PE (2004) Diet, nutrition and the prevention of dental diseases. *Public Health Nutr* 7: 201-226.
- May J, Waterhouse PJ (2003) Dental erosion and soft drinks: a qualitative assessment of knowledge, attitude and behaviour using focus groups of schoolchildren. A preliminary study. *Int J Paediatr Dent* 13: 425-433.
- McGuire J, Szabo A, Jackson S, Bradley TG, Okunseri C (2009) Erosive tooth wear among children in the United States: relationship to race/ethnicity and obesity. *Int J Paediatr Dent* 19: 91-98.
- Amaechi BT, Higham SM (2001) Eroded enamel lesion remineralization by saliva as a possible factor in the site-specificity of human dental erosion. *Arch Oral Biol* 46: 697-703.
- Honório HM, Rios D, Santos CF, Magalhães AC, Buzalaf MA, et al. (2008) Effects of erosive, cariogenic or combined erosive/cariogenic challenges on human enamel. *Caries Res* 42: 454-459.
- von Fraunhofer JA, Rogers MM (2004) Dissolution of dental enamel in soft drinks. *Gen Dent* 308-312.
- Hemingway CA, Parker DM, Addy M, Barbour ME (2006) Erosion of enamel by non-carbonated soft drinks with and without toothbrushing abrasion. *Br Dent J* 201: 447-450.
- Brown CJ, Smith G, Shaw L, Parry J, Smith AJ (2007) The erosive potential of flavoured sparkling water drinks. *Int J Paediatr Dent* 17: 86-91.
- Kitchens M, Owens BM (2007) Effect of carbonated beverages, 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.
- Ehlen LA, Marshall TA, Qian F, Wefel JS, Warren JJ (2008) Acidic beverages increase the risk of in vitro tooth erosion. *Nutr Res* 28: 299-303.
- Milosevic A, Lennon MA, Fear SC (1997) Risk factors associated with tooth wear in teenagers: a case control study. *Community Dent Health* 14: 143-147.
- O'Sullivan EA, Curzon ME (2000) A comparison of acidic dietary factors in children with and without dental erosion. *ASDC J Dent Child* 67: 186-192.
- Sivasithamparam K, Young WG, Jirattanasopa V, Priest J, Khan F, et al. (2002) Dental erosion in asthma: A case-control study from south east Queensland. *Aust Dent J* 47: 298-303.
- Al-Dlaigan YH, Shaw L, Smith AJ (2002) Is there a relationship between asthma and dental erosion? A case control study. *Int J Paediatr Dent* 12: 189-200.
- Al-Majed I, Maguire A, Murray JJ (2002) Risk factors for dental erosion in 5-6 year old and 12-14 year old boys in Saudi Arabia. *Community Dent Oral Epidemiol* 30: 38-46.



39. O'Brien M (1994) Children's Dental Health in the United Kingdom 1993. 1994: Office of Population Censuses and Surveys Her Majesty's stationery Office, London.
40. Walker A (2000) National Diet and Nutrition survey: Young people aged 4 -18 years. Volume 2: Report of the oral health survey 292. 2: The Stationary Office: London. 292.
41. Al-Malik MI, Holt RD, Bedi R (2002) Erosion, caries and rampant caries in preschool children in Jeddah, Saudi Arabia. *Community Dent Oral Epidemiol* 30: 16-23.
42. Arnadóttir IB, Saemundsson SR, Holbrook WP (2003) Dental erosion in Icelandic teenagers in relation to dietary and lifestyle factors. *Acta Odontol Scand* 61: 25-28.
43. Auad S, Waterhouse PJ, Nunn JH, Steen N, Moynihan PJ (2007) Dental erosion amongst 13 -14 year-old Brazilian schoolchildren. *Int Dent J* 57: 161-167.
44. Chadwick, B. and L. Pendry (2003) Non - carious dental conditions. Children's Dental Health in the United Kingdom, 2003. *British Dental Journal* 200: 379 - 384.
45. Larsen MJ, Poulsen S, Hansen I (2005) Erosion of the teeth: prevalence and distribution in a group of Danish school children. *Eur J Paediatr Dent* 6: 44-47.
46. Dugmore CR, Rock WP (2004) The prevalence of tooth erosion in 12-year-old children. *Br Dent J* 196: 279-282.
47. Ganss C, Klimek J, Giese K (2001) Dental erosion in children and adolescents-a cross-sectional and longitudinal investigation using study models. *Community Dent Oral Epidemiol* 29: 264-271.
48. Nunn J (2001) A longitudinal study of dental erosion in adolescent girls. *Caries Research* 35: 296.
49. Dugmore CR, Rock WP (2003) The progression of tooth erosion in a cohort of adolescents of mixed ethnicity. *Int J Paediatr Dent* 13: 295-303.
50. Al-Majed I, Maguire A, Murray JJ (2002) Risk factors for dental erosion in 5-6 year old and 12-14 year old boys in Saudi Arabia. *Community Dent Oral Epidemiol* 30: 38-46.
51. El Karim IA, Sanhoury NM, Hashim NT, Ziada HM (2007) Dental erosion among 12-14 year old school children in Khartoum: a pilot study. *Community Dent Health* 24: 176-180.
52. Al-Malik MI, Holt RD, Bedi R (2001) The relationship between erosion, caries and rampant caries and dietary habits in preschool children in Saudi Arabia. *Int J Paediatr Dent* 11: 430-439.
53. Peres KG, Arménio MF, Peres MA, Traebert J, De Lacerda JT (2005) Dental erosion in 12 year-old schoolchildren: a cross-sectional study in Southern Brazil. *Int J Paediatr Dent* 15: 249-255.
54. WHO (1997) Oral Health Surveys: Basic Methods. 1997: 4 ed. Geneva: WHO Library Cataloging in Publication Data.
55. GAI (2006) Great Socialist People's Libyan Arab Jamahiriya: General Authority of information. A preliminary results of general poulation census 2006.
56. Dugmore CR, Rock WP (2004) The prevalence of tooth erosion in 12 year-old children. *Br Dent J* 196: 279-282.
57. Al-Malik MI, Holt RD, Bedi R (2002) Erosion, caries and rampant caries in preschool children in Jeddah, Saudi Arabia. *Community Dent Oral Epidemiol* 30: 16-23.
58. de Carvalho Sales-Peres SH, Goya S, de Araújo JJ, Sales-Peres A, Lauris JR, et al. (2008) Prevalence of dental wear among 12 year-old Brazilian adolescents using a modification of the tooth wear index. *Public Health* 122: 942-948.
59. Bartlett DW, Coward PY, Nikkah C, Wilson RF (1998) The prevalence of tooth wear in a cluster sample of adolescent schoolchildren and its relationship with potential explanatory factors. *Br Dent J* 184: 125-129.
60. Mungia R, Zarzabal LA, Dang SC, Baez M, Stookey GK, et al. (2009) Epidemiologic survey of erosive tooth wear in San Antonio, Texas. *Tex Dent J* 126: 1097-1109.
61. Kazoullis S, Seow WK, Holcombe T, Newman B, Ford D (2007) Common dental conditions associated with dental erosion in school children in Australia. *Pediatr Dent* 29: 33-39.
62. Correr GM, Alonso RC, Correa MA, Campos EA, Baratto-Filho F, et al. (2009) Influence of diet and salivary characteristics on the prevalence of dental erosion among 12 year-old schoolchildren. *J Dent Child (Chic)* 76: 181-187.
63. Deery C, Wagner ML, Longbottom C, Simon R, Nugent ZJ (2003) The prevalence of dental erosion in a United States and a United Kingdom sample of adolescents. *Pediatr Dent* 22: 505-510.
64. Talebi M, Saraf A, Ebrahimi M, Mahmodi E (2009) Dental erosion and its risk factors in 12 year-old school children in Mashhad Journal of Dentistry (Shiraz University of Medical Sciences) 9: 13-18.
65. Künzel W, Cruz MS, Fischer T (2000) Dental erosion in Cuban children associated with excessive consumption of oranges. *Eur J Oral Sci* 108: 104-109.
66. Caglar E, Kargul B, Tanboga I, Lussi A (2005) Dental erosion among children in an Istanbul public school. *J Dent Child (Chic)* 72: 5-9.
67. Larsen MJ, Poulsen S, Hansen I (2005) Erosion of the teeth: prevalence and distribution in a group of Danish school children. *Eur J Paediatr Dent* 6: 44-47.
68. Al-Dlaigan YH, Shaw L, Smith A (2001) Dental erosion in a group of British 14 year-old, school children. Part I: prevalence and influence of differing socioeconomic backgrounds. *Br Dent J* 190: 145-149.
69. Dugmore CR, Rock WP (2003) The progression of tooth erosion in a cohort of adolescents of mixed ethnicity. *Int J Paediatr Dent* 13: 295-303.