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Dental Erosion in 10 – 12 Year Old Children in Mosul City

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Abstract

The aim of this study was to determine the prevalence of dental erosion among 10-12 year old children in Mosul city, mean erosion in teeth and surfaces, amount of carbonated beverages and fruit juice consumed in the sample, and the correlation between dental erosion and some variables. Total sample consisted of 400 children derived from different primary schools in the city center. Examination was performed according to tooth wear index by Smith and Knight 1984 modified by Millword et al 1994.

Results showed that dental erosion was highly prevalent 74.2% in the sample, increasing with increasing age, with boys showing a higher prevalence in dental erosion compared to girls with significant difference. Mean erosion scores for primary teeth were slightly less then permanent teeth, with a significant difference between 10 and 12 years of age for both dentitions.

Buccal/labial surfaces exhibited more erosion, followed by lingual/palatal and finally occlusal /incisal surfaces, with boys showing more erosion in all surfaces than girls. A large proportion of the sample consumed carbonated beverages 3-5 /week with boys consuming more than girls as seen in the erosion group, fruit juice was also largely consumed by the sample, especially the group that showed erosion. A positive correlation was found between erosion, level of father's education, time of drinking, method, amount of carbonated beverages and fruit juice consumed.

Preventive measures are considered to be the only effective course of management of dental erosion, by reducing intake of carbonated beverages and fruit juice, also modification of erosive drinks, medicines and foods may prove to be an acceptable future strategy world wide.

Key words: Erosion, Fruit juice, carbonated beverage.

Introduction

Tooth wear is becoming more commonly recognized in both adults and children, with recent studies suggesting a prevalence of 98% in adults. [1]The triad of erosion, attrition and abrasion has been known for many years, but erosion is currently believed to be the major factor involved in tooth wear and its contribution may be increasing. Dental erosion has been defined as a progressive irreversible loss of dental hard tissue by a chemical process, usually by acids other than those produced by plaque bacteria. [2,3] Dental erosion is a relatively new risk factor for dental health, introduced by today's lifestyle. [4] Its process can lead to reduction in size of teeth and

depending upon the severity and length of exposure, may lead to the total destruction of the dentition.[3] Causative factors for tooth erosion are divided into extrinsic and intrinsic categories. Intrinsic erosion occurs from involuntary gastrointestinal disturbances such as gastro-esophageal reflux disease (GERD) and from voluntary regurgitation of gastric acids exhibited by anorexic and or bulimic individuals.[4,5]Extrinsic tooth erosion causes include environmental factors medicaments, lifestyle, and diet.[4,5,6]. Clinical studies have found carbonated drinks, especially carbonated cola drinks, to be associated with erosion, most likely due to their low pH. [7,8] .However, in vitro studies have shown that fruit juices may also be potentially erosive, due to their high content of titratable acid .[9,10]

The aim of this study was to determine the prevalence of dental erosion in 10-12 year old children in Mosul city, to investigate which teeth and surfaces exhibited more erosion, the amounts of carbonated beverages and fruit juice consumed in the sample, and the correlation between some variables like level of fathers education, time of drinking carbonated soft drink, amount of carbonated beverages and fruit juice intake and method of drinking on dental erosion.

Materials and Methods

A permission to examine primary schools was obtained, contact with schools authorities was made to explain purpose of the study, different urban areas of Mosul city were chosen because they provide a fair representation of the city's population in terms of socio-economic status. The total sample consisted of 400 children, randomly selected, aged between 10-12 years.

Examination was performed with the child sitting on an ordinary chair in an upright position with his head tilted backward with the aid of dental mirror and explorer under natural day light ,the surfaces of all the teeth present in the mouth were scored for dental erosion according to tooth wear index by Smith and Knight 1984[11] modified by Millword et al 1994[12] according to the following criteria :

0 = No loss of enamel surface characteristics

1 = Loss of enamel surface characteristics

2 = Loss of enamel, visible dentin on less than a third of the surface area (involving buccal, lingual or occlusal surfaces), loss of enamel with visible dentin (incisal).

3 =Loss of enamel, visible dentin on more than a third of the surface area (involving buccal, lingual or occlusal surfaces), or loss of enamel and substantial loss of dentin but not exposing pulp or secondary dentin (incisal surface).

4=Complete loss of enamel, pulp exposure or exposure of secondary dentin (involving buccal, lingual or occlusal surfaces), or pulp exposure or exposure of secondary dentin (incisal surfaces)

9= Excluded from analysis(missing tooth, partially erupted, large restoration, extensive caries, orthodontic band, composite restoration, any crowns, tooth fracture and fissure sealant).

The examination was performed to all the buccal/incisal, occlusal/incisal and lingual /palatal surfaces of each tooth present.

For the permanent dentition only incisor and permanent first molar were examined (due to their early eruption) other permanent teeth were not affected by erosion as first and second premolars had just erupted and

permanent canine and second permanent molars were not some times present, for primary teeth, canines, first and second primary molars were examined.

A structured questionnaire to record the usual consuming habits was used and filled according to the Childs answer and was divided in to:

1=those consuming 2 carbonated beverages / week or less

2=those consuming 3-5 carbonated beverages /week.

3=those consuming 6 carbonated beverages /week or more

For fruit juice:

1=those infrequently consuming/week or not consuming fruit juice/week

2=those consuming once/day

3=those consuming more than once /day

Educational level of head of house hold was classified in to:

1= illiterate or finished primary school.

2= finished intermediate or secondary school.

3=finished college or diploma.

4= higher educational level (M Sc, Ph D)

Time of drinking was divided in to through out the day or last thing at night, method of drinking was divided in to directly from container, swishing of the solution in mouth and swallowing or with straw.

The data were recorded and analyzed using the Statistical Package for the Social Sciences – version 10.5, descriptive analysis including mean, standard deviation, frequency and percentages, Student's t test and Duncan's Multiple Range test were performed when indicated ,results were significant when p≤ 0.05.

The incisal edge of the anterior teeth was excluded from this analysis, as these surfaces are particularly subjected to attrition. ([13])

Results

Table (1) displays the frequency and percentage of dental erosion in children, the sample was composed of 400 child of which 103 were erosion free, while 297 exhibited the condition (three quarter of the sample).

Table (2) demonstrates that that 62.4 % of 10 year old exhibited the condition increasing to76.8% in 11 year olds and becoming 83.7% in 12 years of age, while Table (3) shows that dental erosion was more prevalent in boys s 81.9% compared to 64.4% in girls.

Table (4) demonstrates the mean erosion scores for primary teeth in the sample, there was a statistically significant increase in erosion scores with increasing age for primary teeth from 10 to 12 years with no significant difference between age groups 10 and 11, mean erosion was most in primary canine, followed by primary second molars and the least in primary first molar.

Table (5) displays the mean erosion scores for permanent incisors and first molars, there was an increase in mean erosion with age, with no significant difference between age groups 10 and 11 years for both teeth and significant difference existed between age groups 10 and 12 years, with permanent incisors showing a higher mean erosion compared to permanent first molar for all age groups.

It can be seen in table (6) the mean erosion scores according to the surfaces of the sample for both males and females , the buccal/ labial surfaces exhibited the most erosion followed by lingual/ palatal surfaces and least erosion on occlusal/ incisal surfaces, with boys exhibiting more erosion with highly significant difference then girls in all surface types. The same pattern can be noticed in Table (7) that demonstrates mean

erosion scores according to the surfaces in each age group, as the buccal/ labial surfaces exhibited the most erosion followed by lingual/ palatal surfaces and least erosion on occlusal/ incisal surfaces, with significant difference in mean erosion scores between age groups 10 and 12 years and no significant differences observed between 10 and 11 years for all surfaces.

Table (8) shows the number and percentage of children with erosion in relation with amount of carbonated beverages consumed per week, the majority of children with erosion consumed carbonated beverages 3-5 times/week (55.68 % boys, 74.11 % girls), while Figure (1) displays the amount of carbonated beverages consumed by the total sample, 36.5% of the sample consumed 3-5 carbonated beverages /week.

Table (9) displays number and percentage of children with erosion in relation with amount of fruit juice consumed, similar results were observed with the pattern of consumption for both girls and boys as 41.6% of boys and 41.1 % of the girls consumed fruit juice once per day and 17.3% of boys consumed more than once per day and 18.7% for girls.

Figure (2) demonstrates the amount of fruit juice consumed by the total sample, 32.25% consumed fruit juice once /day. It can be demonstrated in Table (10) that a positive correlation existed between dental erosion and the level of fathers education, time and method of consumption and amount of carbonated beverages and fruit juice consumed for all the total sample, all age groups and both gender.

Discussion

There has been a continuing increase in soft drink and beverages consumption among adolescents globally [14] which has raised a concern about the health effects of soft drinks and beverages. They are sugar-containing drinks that can be cariogenic [15] and their low pH can cause erosion in teeth. [2]

The study showed that the prevalence of dental erosion was high in this age group in both the deciduous and permanent dentitions (74.2%) as shown in Table (1), suggesting that this type of condition is beginning to constitute a public health problem for this group, this finding contradicts a previous study conducted in Mosul that found that the prevalence was low [16] and other studies [17,18], but it is in agreement with other studies [19,20] and the figure is less than a study by Al-Majed et al [21] in Saudi Arabia that found that dental erosion was prevalent in 95% of their sample ,The prevalence of erosion was increasing with increasing age as it was 62.4% in 10 year old reaching to 83.7% in 12 year olds (Table 2).

Boys showed a significantly higher prevalence of erosion 81.9% than girls (Table 3) , this is in agreement with other studies [22,23] , which might be attributed to that boys consume more fizzy drinks than girls. [24]

Tables(4) and (5) demonstrate the mean erosion scores for the total sample for both the primary and permanent teeth, No significant differences existed between mean scores in 10 and 11 year old for both dentitions, while significant difference existed between age groups 10 and 12 years, which might be attributed to the accumulative nature of dental erosion through out the life, as teeth are subjected to various types of acidic food and drinks, in addition to the consumption of carbonated beverages. The study showed that mean erosion scores for the permanent teeth (incisors and permanent first molars) had higher scores compared to the mean

erosion scores in the primary teeth , this finding contradicts the results of Johansson et al (2002)[25], which might be attributed to the reason to that the rate of consumption of soft drinks was increasing after 6 years of age due to many demographic and financial changing variables in our country that affected the newly erupting teeth compared with the primary teeth.

An absolute comparison of the mean prevalence scores of this study with others is not possible primarily due to the different grading system used and dissimilar age and gender composition and sample size.

The need for a standardized and internationally accepted index is obvious, but there continues to be research needs which may not be fulfilled with a simplified index. Over the past 20 to 30 years, different researchers have developed indices which suit their own research needs but do not allow comparison to assess the prevalence of tooth wear between countries and regions. Table (6) displays that the mean erosion scores according to the surfaces in both gender, boys demonstrated more erosion than girls in all tooth surfaces than girls with significant difference at $p \leq 0.01$.

It can be demonstrated in table (7) that the mean erosion scores were higher in lingual / palatal surfaces than occlusal / incisal surfaces , no significant difference existed between them ,the labial/ buccal surfaces of the teeth for all age groups and the total sample exhibited the greatest erosion mean with significant difference at 12 years of age with no significant difference in 11 and 10 year olds, the same pattern can be seen for the lingual /palatal, occlusal /incisal surfaces as well for all age groups. Labial /buccal surfaces were shown to have a higher mean erosion values in another study. [26]

It can be determined from Figure (1) the amount of carbonated beverages consumed by the whole sample, 36.5% of the sample consumed carbonated beverages between 3-5 times/ week and 23.5% consumed 6 beverages / week or more. Table (8) shows the amount of carbonated beverages consumed in the sample that showed erosion (185 boys, 112 girls), since the last occupational war in Iraq, canned and bottled soft drinks have become readily available and relatively cheap compared with previous years of the embargo on Iraq, were such products were not readily available and expensive, in addition to opening several new factories for manufacturing canned carbonated beverages through out the country. Carbonated drinks, especially carbonated cola drinks, are associated with erosion, most likely due to their low pH [8], Cola drinks have more than ten-fold higher erosive potential than orange juices within the first minutes after exposure. This high erosive potential corresponded well to the pH of the cola drinks.[27,28]

Figure (2) demonstrates the amount of fruit juice consumed for the total sample, it can be noticed that 32.25% of the sample consumed fruit juice once per day, while 17% consumed more than one time daily. Table (9) shows the amount of juice consumed for the children that showed erosion, percentages were similar for both boys and girls. According to a study [18] the consumption of industrialized beverages, especially soft drinks ingested with a frequency of at least three times a week, had a statistically significant association with the occurrence of dental erosion as the children who consumed soft drinks exhibited 3.5 times more dental erosion than others, also fruit juice drinks again contain lots of citric acid. Even when diluted down, the

concentration of acid can be high enough to cause a small, but cumulative, amount of damage to the tooth structure resulting in erosion. Not only fruit juice and fizzy drinks contribute to the development of dental erosion, other sources of acid from fruits, vinegar containing foods such as pickles and sauces may have an effect on erosion and should be considered in future studies. Table (10) shows that a positive correlation existed between dental erosion and the level of fathers education, time and method of consumption and amount of carbonated beverages and fruit juice consumed , increase in level of fathers education results in an increase in dental erosion, Millward et al (1994)[12] reported a higher prevalence of erosion in high socioeconomic group, which might be attributed to that rich people purchase more fizzy and fruit juice than other socio-economic classes. Also time of consumption was an important factor in development of erosion, as dental erosion increased when the fizzy drink or juice was consumed the last thing at night, this is in agreement with the findings of Moynihan (2002)[29]

Method of intake was also an important factor, as intake with the use of a straw may reduce the erosive potential of drink if positioned properly toward the back of the mouth. [30,31]A large proportion of our sample claimed to use of a straw in consumption, this is in contrast to a previous study [16], were straw was rarely used in consumption.

Also amount of carbonated beverages and fruit juice showed a positive correlation with dental erosion, clinical studies have found carbonated drinks, especially carbonated cola drinks associated with erosion, most likely due to their low pH [7,8,30]. However, in vitro studies have shown that fruit juices may also

be potentially erosive, due to their high content of titratable acid. [9]

In view of the extensive damage inflicted by the chronic, excessive intake of carbonated beverages, preventive measures are considered to be the only effective course of management, by reducing the amount and frequency of intake, also drinks should be drunk quickly rather than sipped, restricting the intake to main meal time, and avoid taking them the last thing at night, and use of a straw

Topical fluorides can also by used in order to prevent the progression of erosion [33] and promote enamel rehardening, also finishing the meal with some thing alkaline such as a piece of cheese or milk, another point put in mind is to avoid tooth brushing for an hour after intake of acid substances, it has been found that if teeth are brushed immediately, up to five times more enamel is removed.[34]Other factors present in the saliva such as flow rates, salivary proteins especially the acquired pellicle that covers the tooth surfaces, have an effect in reducing amount of dental erosion .[27]

It is clear from a review of existing epidemiological studies that more population-based studies are needed. These studies should clearly delineate erosion, with identification of etiologic factors.

Conclusion

A considerable increase in tooth wear has been observed in recent years. Mostly, erosion though often complicated by other forms of tooth wear. Careful diagnosis and monitoring of progress are important and the underlying aetiological factors should be corrected wherever possible. The aetiology of tooth wear is often complex but individualised prevention can usually only be initiated once the

disease has started. This is largely aimed at limiting progression of tooth wear in the affected individual. Modification of erosive drinks, medicines and foods may prove to be an acceptable future strategy for manufacturer and customer alike. Careful monitoring of patients following diagnosis of tooth wear, removal of causative factors and relatively simple dental treatments may enable the patient to avoid extensive restorative procedures.

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Table(1) Prevalence of dental erosion in the total sample

Erosion	Frequency	Percentage
No	103	25.8
Yes	297	74.2

Table(2) Prevalence of dental erosion with in the age groups

Age Group (Years)	Erosion	Frequency	Percentage
10	No	50	37.6
	Yes	83	62.4
11	No	32	23.2
	Yes	106	76.8
12	No	21	16.3
	Yes	108	83.7

Table(3) Prevalence of dental erosion according to gender

Gender	Erosion	Frequency	Percentage
Males	No	41	18.1
	Yes	185	81.9
Females	No	62	35.6
	Yes	112	64.4

Table (4) Mean erosion scores for the primary teeth

Age (Years)	No.	Mean Erosion in Primary canine ±(SD)	Mean Erosion in first primary molar ±(SD)	Mean Erosion in second primary molar ±(SD)
10	133	0.060 (0.009)A	0.043 (0.008) A	0.063(0.009) A
11	138	0.073 (0.010)A	0.054 (0.007) A	0.068(0.008) A
12	129	0.176 (0.016)B	0.123 (0.013) B	0.158 (0.013) B

• Means with same letter were statistically not significant ($p > 0.05$).

Table(5) Mean erosion scores for the permanent teeth

Age (Years)	No.	Mean Erosion in permanent incisors	Mean Erosion in permanent molars+ SD
10	133	0.172(0.202)A	0.117(0.012)A
11	138	0.176(0.169)A	0.166(0.013)A
12	129	0.372(0.271)B	0.325(0.025)B

Duncan's Multiple Range test
Means with same letters are statistically not significant ($p > 0.05$)

Table (6) Mean erosion according to the surfaces for both gender

Surfaces	Gender	No.	Mean	± SD	t–value	df	p–value
Buccal/ Labial	Males	226	0.264	0.217	7.562	398	0.000**
	Females	174	0.116	0.156			
Lingual/ Palatal	Males	226	0.209	0.187	7.079	398	0.000**
	Females	174	0.094	0.118			
Occlusal/ Incisal	Males	226	0.159	0.222	7.236	398	0.000**
	Females	174	0.118	0.150			

Student's t test
** Significant difference existed at $p \leq 0.01$

Table (7) Mean erosion scores according to the surfaces in each age group

Age (Years)	No.	Mean erosion+ SD Labial/Buccal	Mean erosion+ SD Lingual /palatal	Mean erosion+ SD Occlusal /Incisal
10	133	0.136(0.013)A	0.135(0.013)A	0.106(0.011)A
11	138	0.159(0.014)A	0.142(0.012)A	0.116(0.010)A
12	129	0.309(0.022)B	0.222(0.026)B	0.259(0.019)B
Total	400	0.244(0.027)(A)	0.172(0.029)(B)	0.147(0.021)(B)

Duncan's Multiple Range test
Means with same letters are statistically insignificant
Capital letters compare between different age groups
Capital letters between brackets compare between totals

Table (8) Number and Percentage of children with erosion in relation with amount of carbonated beverages consumed per week

Carbonatedbever ages	Less than 2/week No. erosion %		3-5 /week No. erosion %		6 /week or more No. erosion %	
Males	20	10.81	103	55.68	62	33.51
Females	15	13.39	83	74.11	14	12.50

Table (9) Number and Percentage of children with erosion in relation with amount of fruit juice consumed

Fruit juice	not consum fruit juice/week or frequently /week		once/day		more than once /day	
	No.erosion	%	No. erosion	%	No. erosion	%
Males	**76**	**41.1**	**77**	**41.6**	**32**	**17.3**
Females	**45**	**40.2**	**46**	**41.1**	**21**	**18.7**

Table (10) Correlation (Spearman's correlation) between dental erosion and some variables

	Spearman's Correlation	Father's Education	Before Bed	Method	Carbonate beverages	Fruit juice
Erosion of Total Sample	Correlation Coefficient p–value No.	0.201** 0.000 400	0.306** 0.000 400	0.643** 0.000 400	0. 253** 0.000 400	0.128** 0.010 400
Age Group: 10 Years	Correlation Coefficient p–value No.	0.334** 0.000 133	0.382** 0.000 133	0.668** 0.000 133	0.442** 0.001 133	0.137* 0.017 133
Age Group: 11 Years	Correlation Coefficient p–value No.	0.128 0.136 138	0.274** 0.001 138	0.640** 0.000 138	0.448** 0.007 138	0.227** 0.008 138
Age Group: 12 Years	Correlation Coefficient p–value No.	0.076 0.391 129	0.247** 0.005 129	0.566* 0.000 129	0.209* 0.009 129	0.106* 0.004 129
Gender : Males	Correlation Coefficient p–value No.	0.144* 0.030 226	0.286** 0.000 226	0.630** 0.000 226	0.315** 0.004 226	0.221* 0.009 226
Gender : Females	Correlation Coefficient p–value No.	0.235** 0.002 174	0.308** 0.000 174	0.607** 0.000 174	0.166* 0.387 174	0.114* 0.134 174

* Correlation is significant at the 0.05 level.
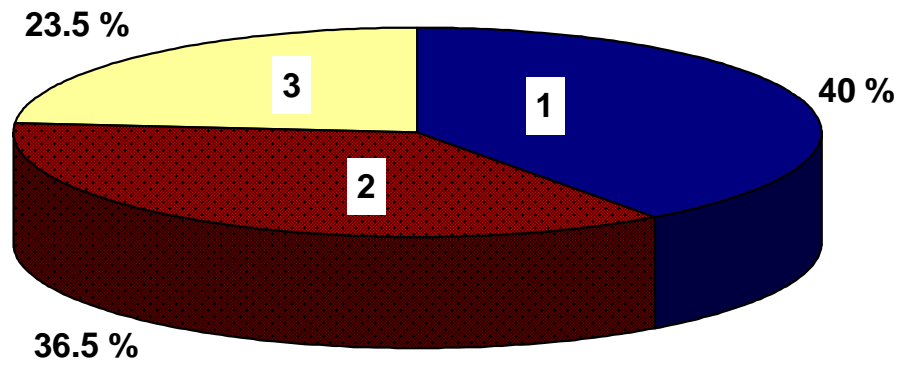** Correlation is significant at the 0.01 level.

Figure (1): Amount of carbonated beverages consumed/ week for the total sample.
 1= (2 carbonated beverages / week or less)
2= (3 - 5 carbonated beverages / week)
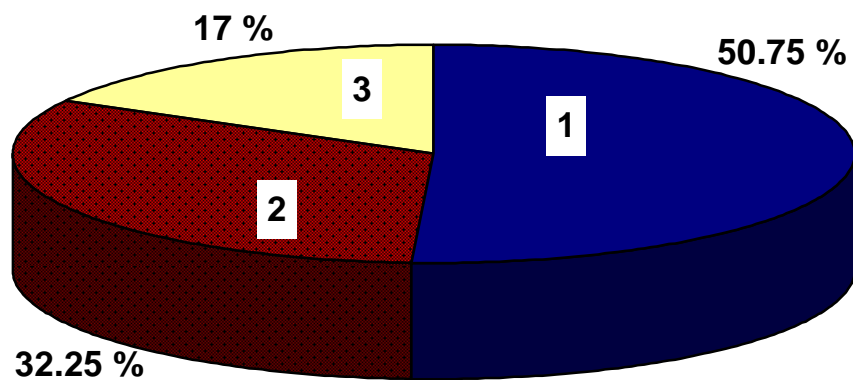3= (6 carbonated beverages / week or more)

Figure (2): Amount of fruit juice consumed / day for the total sample.
1= Infrequently or non/week
2= One time / day
3= More than once / day