

The Impact of Carbonated Drinks on the Onset of Dental Erosions in the First Permanent Incisors and Molars in Examinees at the Age from 10 to 29 Years

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Summary: The goal of the study was to determine the association between carbonated drinks and the prevalence of dental erosions, according to gender in examinees at the age from 10 to 29 years.

In the study we included 46 examinees at the age from 10 to 29 years, from whom 25 (54.3%) were female, and 21 (45.7%) were male, at the age from 10 to 29 years. The study was consisted from clinical examinations, which meant, keeping a record of the consumption of carbonated drinks, and the existence of dental erosions on the first permanent incisors and molars.

The results in the presented distribution of dental erosions diagnosed on the central incisors and the first permanent molar, for Pearson and $p > 0,05$, in correlation to the gender of the examinees does not have a significant difference.

In the presented distribution of dental erosions according to dental surfaces in correlation to the gender of the examinees and the use of carbonated drinks and dental erosions diagnosed on the central incisors and the first permanent molar, for $p < 0,001$ there is a significant difference.

As a conclusion, we would like to note, that the dentists should be more active in the promotion of health, in terms of stopping dental erosions.

Keywords: dental erosions, carbonated drinks, central incisors and first permanent molar

I. Introduction

Humans during their whole life have their teeth exposed to a great number of harmful influences, which, more or less contribute to the onset of loss of the morphological characteristics of the teeth. According to Lussi[1], the etiology of the dental erosions is polyvalent and is not completely explained, nevertheless it is based on the mutual influence from chemical factors, biological factors and patient based factors, and still some individuals have dental erosions while others don't, whilst being exposed to the same quantity of acid and have a similar lifestyle, says Lussi[1]. Still, most frequently mentioned factors are the use of acid food and citric fruits (multiple times a day), general food disorders, bruxism, stress, frequent vomiting, ongoing or history of gastrointestinal reflux. [2] Although there are many causes of erosive tooth conditions, when chemical factors are taken into account, dental erosion can be defined as a chronic effect of the teeth with internal and external acids, and also the saliva with its pH, adhesion, chelating ability and unsaturation of minerals needed in the dental tissues (Ca, P, Florida), can also contribute to the occurrence of dental erosions. [3,4] The emergence of this situation, has been the subject of research since the early 19th century, and since then, the incidence and prevalence of dental erosion is increasingly becoming a subject of research worldwide. [5] The prevalence of loss of dental tissues, is a frequent clinical problem, which is present up to 97%. The literature states that the prevalence of erosions is the most typical and ranges between 35-57%. [6,7,8] Studies, which study the prevalence of dental erosions, were done with different methods where the authors used different indices and measurements for the diagnosis and then they noted every wearing of the teeth not only the erosions. Most of the studies, only focus on the population of Europe, because of the need to carefully compare results to the findings from the general population in the US, but the assessment of the problem among the general population, is approximately equal. [9] The fact of the damaging impact of different types of drinks, motivates us to focus our labor toward establishing the connection between carbonated drinks and prevalence of dental erosions on surfaces, according to gender.

II. Material And Methodology

The total sample consisted of 46 examinees aged 10 to 29 years, of which 25 (54.3%) were female and 21 (45.7%) were male.

The study was designed with the following clinical methods

1. Clinical procedures

1.1. The diagnosing of dental erosion was made with a visual exam and in the questionnaires we classified them according to the recommendations of Smith and Knight and later Millward et al., in which the following criteria were taken into account:

0 = Without lesions on the enamel of the teeth surface

1 = Only superficial loss of teeth enamel

2 = Enamel loss, dentin exposed on less than one third of the surface of the tooth (including buccal, lingual and occlusal surfaces or incisal edges of the teeth)

3 = Enamel loss, dentin exposed and loss of more than one third of the tooth surface (including buccal, lingual and occlusal surfaces or incisal edges of the teeth), without exposing the pulp

4 = Complete enamel loss, exposed pulp or secondary dentin (including buccal, lingual and occlusal surfaces or incisal edges of the teeth)

9 = Teeth excluded from the analysis (anodontia or non-grown tooth, partly grown, teeth with large restorations or large carious lesions).

In the tests we included only the central incisors and the first permanent molars in which buccal, lingual, occlusal surfaces and incisal edges of the teeth were inspected.

2.1 Diagnosing dental erosions according to the surfaces of teeth

In the study we included only the central incisors and first permanent molars, and a subject of inspection were the buccal, the lingual, the occlusal surfaces and the incisal edges of the incisors. Diagnosis of dental erosions, according to the surfaces of the teeth, was done as follows:

1=Buccal/labial

2=Lingual/palatal

3=Occlusal-incisal

2.Structuredquestionnaire

It contained the habits of consuming carbonated drinks and fruit juices.

A. According to the respondents' answers about consuming soft drinks we made the notation as follows:

1 = consuming soft drinks 2 times per week or less

2 = consuming soft drinks 3-5 times a week

3 = consuming soft drinks 6 or more times a week

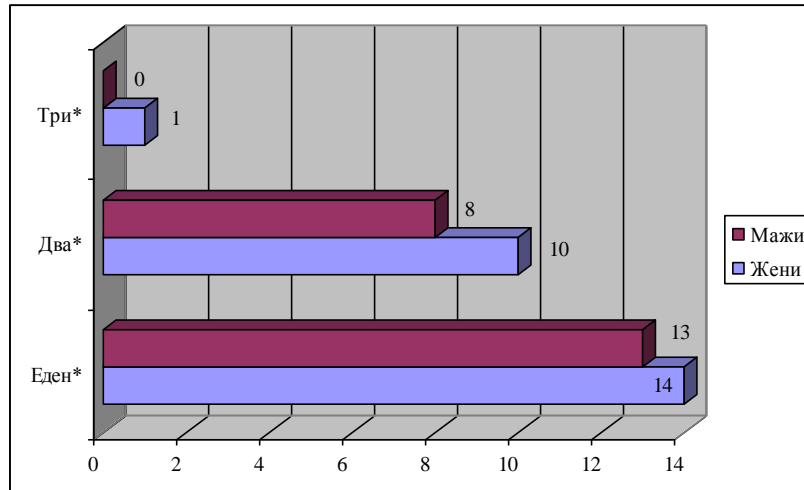
III. Results

The first group consists of 46 examinees aged 10 to 29 years, of which 25 (54.3%) were female and 21 (45.7%) were male (Table and Chart 1).Among the 25 female examinees, in terms of dental erosions on the central incisors, 14 (30.4%) had only superficial loss of dental enamel, 10 (21.7%) had loss of enamel and exposed dentin on less than one third of the tooth surface and 1 (2.2%) patient is diagnosed with loss of enamel, exposed dentin and losing more than one third of the surface of the tooth without an exposed pulp.In 21 male students, in terms of dental erosions on the central incisors, 13 (28.3%) had only superficial loss of dental enamel, and 8 (17.4%) patients had a loss of enamel and an exposed dentin on less than a third of the tooth surface.In the displayed distribution of dental erosions diagnosed on the central incisors, for Fisher's Exact test = 0,89 and $p > 0,05$ ($p = 1,00 / 1,00-1,00$) in relation to the gender,there is no significant difference .

Table 1. Gender / Dental erosions / Central incisors

Gender			Central incisors			Total
			Score 1	Score 2	Score 3	
Female	Count		14	10	1	25
	% of Total		30,4%	21,7%	2,2%	54,3%
Male	Count		13	8	0	21
	% of Total		28,3%	17,4%	,0%	45,7%
Total	Count		27	18	1	46
	% of Total		58,7%	39,1%	2,2%	100,0%

One / Only superficial loss of tooth enamel; Two/Loss of enamel, exposed dentin on less than one third of the tooth surface; Three/Loss of enamel, exposed dentin and loss of more than one third of the tooth surface, without an exposed pulp



Graph 1. Gender / Dental erosions / Central incisor

The data related to dental erosions on the first permanent molar, in relation to the gender of the examinees, are shown in table and graph 2. Among the 25 female examinees in terms of dental erosions of the first permanent molars, 14 (30.4%) had only superficial loss of dental enamel and 11 (23.9%) patients were diagnosed with loss of enamel and exposed dentin on less than one third of the tooth surface.

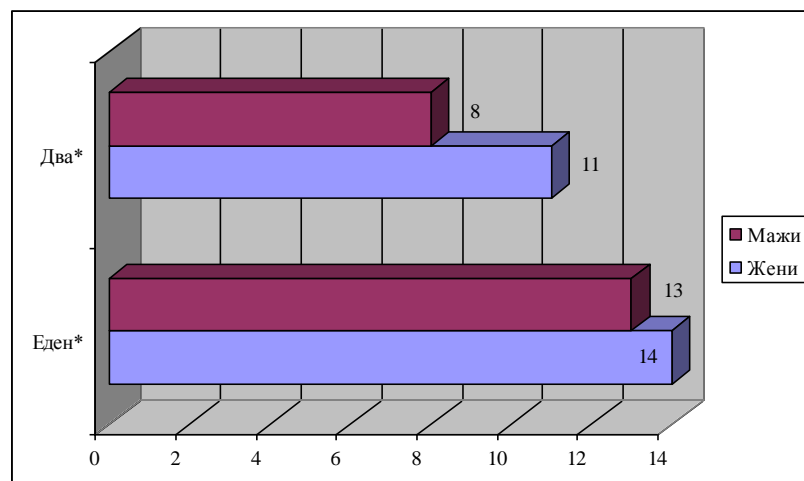
In 21 male examinees, in terms of dental erosions on the first permanent molars, 13 (28.3%) had only superficial loss of dental enamel and 8 (17.4%) patients had loss of enamel, and exposed dentin on less than one third of the tooth surface.

In the displayed distribution of dental erosion diagnosed on the first permanent molar, for Pearson Chi-Square = 0,17, and $p > 0,05$ ($p = 0,69$), in relation to the gender, there is no significant difference.

Table 2. Gender / Dental erosions / First permanent molar

		First permanent molar			Total
		Score 1	Score 2		
Gender	Female	Count	14	11	25
		% of Total	30,4%	23,9%	54,3%
	Male	Count	13	8	21
		% of Total	28,3%	17,4%	45,7%
Total		Count	27	19	46
		% of Total	58,7%	41,3%	100,0%

One / Only superficial loss of tooth enamel; Two/Loss of enamel, exposed dentin on less than one third of the tooth surface



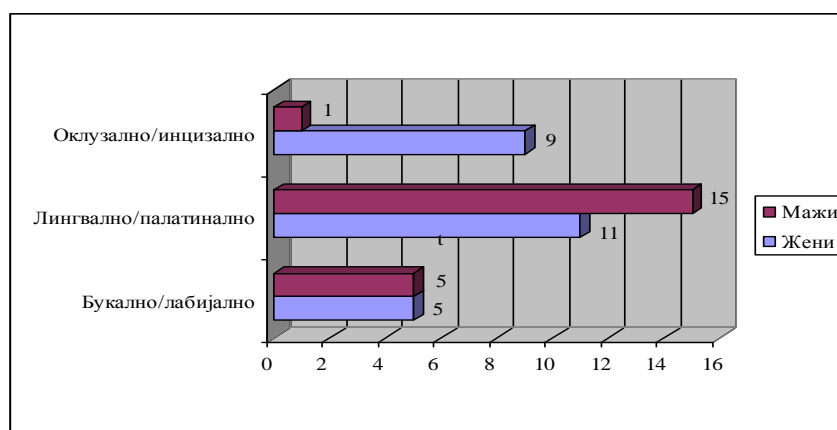
Graph 2. Gender / Dental erosions / First permanent molar

The data related to dental erosions according to the surfaces of the teeth, in relation to the gender, indicated that the 25 female examinees in terms of dental erosions according to the surfaces of the teeth, showed

that 5 (10.9%) had dental erosions on the buccal / labial surface, 11 (23.9%) had dental erosions on the lingual / palatal surface, and 9 (19.6%) patients had dental erosions on the occlusal / incisal surface. From 21 male examinees in terms of dental erosions according to the surfaces of teeth, 5 (10.9%) had dental erosions on the buccal / labial surface, 15 (32.6%) had dental erosions on the lingual / palatal surface and 1 (2.2%) patient had dental erosions on the occlusal / incisal surface. In the displayed distribution of dental erosions according to the surfaces of the teeth, the Fisher's Exact test = 6,83 and $p < 0,05$ ($p = 0,03 / 0,029-0,039$) in relation to the gender of the examinees, there is no significant difference (table and graph 3).

Table 3. Gender / Surface

		Surfaces of the teeth			Total	
		Buccal/ Labial	Lingual/ Palatal	Occlusal/ incisal		
Gender	Female	Count	5	11	9	25
		% of Total	10,9%	23,9%	19,6%	54,3%
	Male	Count	5	15	1	21
		% of Total	10,9%	32,6%	2,2%	45,7%
Total		Count	10	26	10	46
		% of Total	21,7%	56,5%	21,7%	100,0%



Graph 3. Gender / Surface

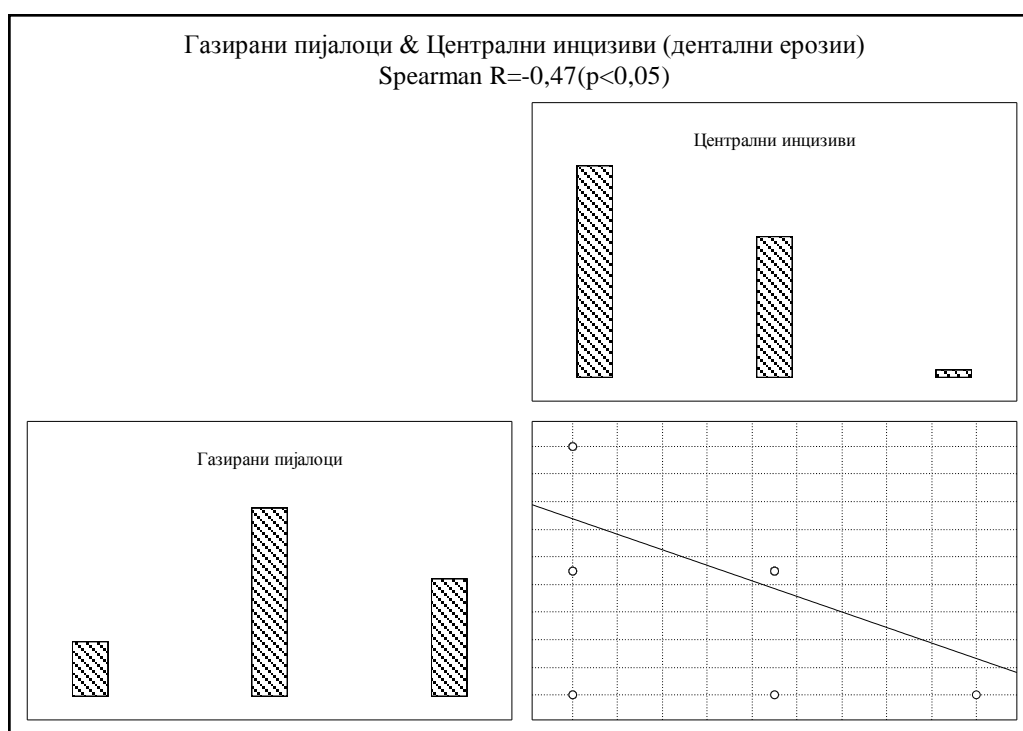
Data relating to the use of carbonated drinks, and dental erosions diagnosed on the central incisors, are shown in Table 4. From 7 (15.2%) patients which used carbonated drinks, with or without sugar, 2 times a week or less, 4 (8.7%) patients had only superficial loss of dental enamel on the teeth; 2 (4.3%) patients had a loss of enamel and exposed dentin on less than one third of the tooth surface and 1 (2.2%) patient had loss of enamel, exposed dentin and losing of more than one third of the surface of the tooth, without an exposed pulp. From 24 (52.2%) patients which used carbonated drinks with or without sugar 3-5 times a week, 8 (17.4%) patients had only superficial loss of enamel on the teeth and 16 (34.8%) patients had a loss of enamel and exposed dentin on less than one third of the tooth surface. 15 (32.6%) patients which used carbonated drinks with or without sugar, 6 or more times a week, were diagnosed only with superficial loss of dental enamel.

In the displayed distribution of data, concerning the use of carbonated drinks, and dental erosions diagnosed on the central incisors, the Fisher's Exact test = 22,916 and $p < 0,001$ ($p = 0,000 / 0,000-0,000$), and there is a significant difference.

Table 4. Carbonated drinks / Dental erosions / Central incisors

		Central incisor			Total		
		Score 1	Score 2	Score 3			
Carbonated drinks	During the week	2 times a week or less	Count	4	2	1	7
			% of Total	8,7%	4,3%	2,2%	15,2%
	3-5 times weekly	Count	8	16	0	24	
		% of Total	17,4%	34,8%	,0%	52,2%	
	6 or more times weekly	Count	15	0	0	15	
		% of Total	32,6%	,0%	,0%	32,6%	
Total		Count	27	18	1	46	
		% of Total	58,7%	39,1%	2,2%	100,0%	

The relationship between the use of carbonated drinks and dental erosions of the central incisors, for $R = -0,47$ and $p < 0,05$ we determined a medium strong negative significant correlation. The increase in use of carbonated beverages is followed by a declining level of erosive changes (graph 4).



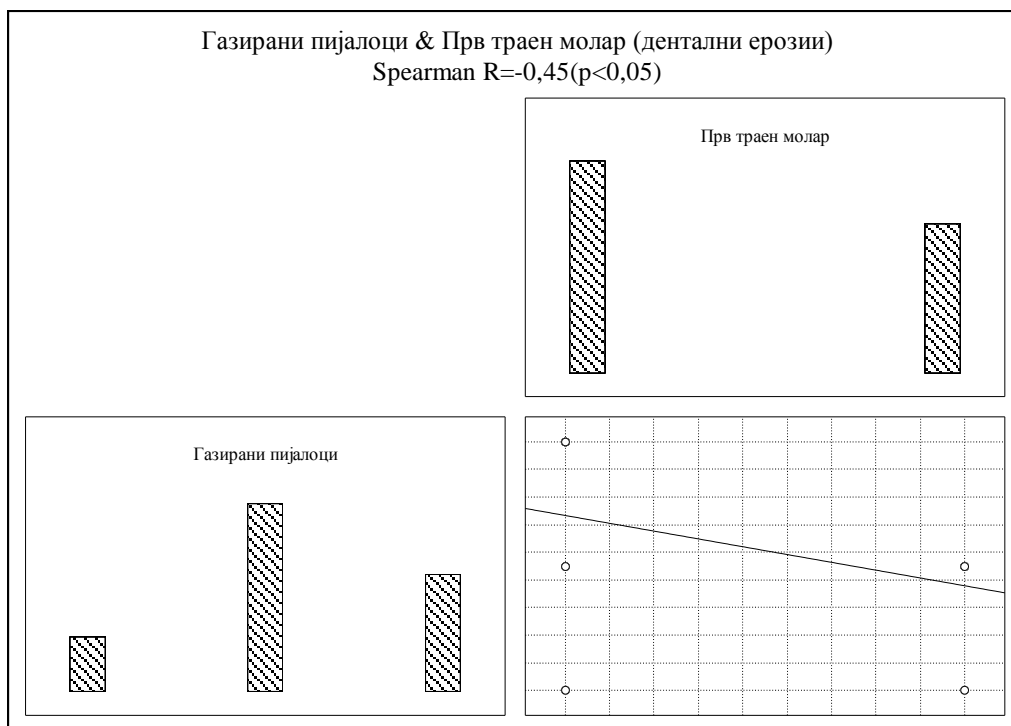
Graph 4.

Data relating to the use of carbonated drinks and dental erosions diagnosed on the first permanent molar (Table 5), indicate that from 7 (15.2%) patients which used carbonated drinks with or without sugar, 2 times a week or less, 4 (8,7%) patients had only superficial loss of dental enamel and 3 (6,5%) patients had a loss enamel and exposed dentin on less than one third of the tooth surface. From 24 (52.2%) patients which used carbonated drinks with or without sugar 3-5 times a week, 8 (17,4%) patients had only superficial loss of dental enamel, and 16 (34,8%) patients had loss of enamel and exposed dentin on less than one third of the tooth surface. 15 (32,6%) patients which used carbonated drinks, with or without sugar, 6 or more times a week, had only superficial loss of dental enamel. In the displayed distribution of data concerning the use of carbonated drinks and dental erosions diagnosed on the first permanent molar for Fisher's Exact test = 19,14 and $p < 0,001$ ($p = 0,000 / 0,000-0,000$) there is a significant difference.

Table 5. Carbonated drinks / Dental erosions & First permanent molar

			First permanent molar		Total
			Score 1	Score 2	
Carbonated drinks	2 times a week or less	Count	4	3	7
		% of Total	8,7%	6,5%	15,2%
	3-5 time weekly	Count	8	16	24
		% of Total	17,4%	34,8%	52,2%
	6 or more times weekly	Count	15	0	15
		% of Total	32,6%	,0%	32,6%
Total	Count	27	19	46	
	% of Total	58,7%	41,3%	100,0%	

Graph 6 displays the relationship between the use of carbonated drinks and dental erosions on the first permanent molar. For $R = -0,45$ and $p < 0,05$ there is a medium strong negative significant correlation, and with the increased use of carbonated beverages there is a decline in the extent of erosive changes.



IV. Discussion

The dental erosions include histological changes in the dental substances which in the early stages, change the mechanical and physical properties of the teeth, due to loss of minerals, often as a result of action of erosive acids. In the mentioned processes the enamel and dentin are affected differently. [10] The prevalence of dental erosions has not been well documented, and they occur frequently in all societies and ages, but today, abrasion of the teeth, represents a much more frequent cause in adults. [11,12] Today, as the most common causes, are mentioned acids, which are present in carbonated drinks such as Coca-Cola. Caglar and collaborators studied the prevalence, clinical presentation and etiology of the dental erosions among 153 children of both genders, aged 11 years, from public schools in Istanbul and established the presence of erosions in 28% of the examinees. [13]

Dental erosions have been investigated for a long time, in both developed and developing countries, and the prevalence varies considerably in different countries, geographical locations, and age groups. However, information about dental erosion in China is scarce, says Wang [14]. The results from our studies, that addressed the distribution of erosions, by sex and age, indicated that in both the central incisors, and the first permanent molars, the most widespread changes were superficial loss of dental enamel (30.4%) among female examinees, and (28.3%) among male examinees. The data relating to dental erosions, according to the surfaces of the teeth, in relation to the gender, indicated that the greatest number, 32.6%, were changes of the palatal and the lingual surfaces in teeth of male examinees, and 23.9% were changes to the same surfaces in female examinees. The buccal and labial areas were equally represented in both sexes (10.9%) and the least changes were seen on the occlusal and lingual surfaces in male examinees. (2.2%)³

Today, dental erosions occur almost on all surfaces of the teeth, but the palatal surface of the maxillary central incisors and the occlusal surfaces of lower molars are most frequently attacked [15], which corresponds with the results we got. Smith [16] considers that although approximal erosive lesions are difficult to diagnose, they are most probably very rare. Our result is consistent with studies carried out by Al-Dlaigan. [17] The results that we got, almost entirely correspond with the analysis of studies by Al-Zarea [18], whose results have shown, that there are no differences in the prevalence of dental erosions between the genders, which is explained with the same or similar means of risk factors, with which Chu [19] and Mulic [20] agree. The results of our research show that the majority of examinees (42.8%) had erosive changes with loss of dental enamel and exposed dentin on less than one third of the tooth surface (score 2) on the central incisors and first permanent molar while consuming carbonated drinks 3-5 times daily.⁵

The relationship between the use of carbonated beverages and dental erosions on central incisor and the first permanent molar, showed a medium strong negative significant correlation. The increase in use of carbonated beverages is followed by a decreased degree of erosive changes ($p < 0,05$).

Clinical studies indicate that carbonated beverages, in particular carbonated cola drinks, are closely associated with the occurrence of dental erosions, likely due to their low pH. [21] However, In vitro studies demonstrated that fruit juices can also be potentially erosive agents because of their high content of titraticacid [22].

Dugmore [23] et al. found that the consumption of acidic foods, fruit juices and soft drinks are directly related to the phenomenon of erosion, which is also the case with our examinees.

The distribution showed a predominance of changes, from an erosive nature, on the occlusal surfaces (mandibular molars), and then the surfaces of the maxillary central incisors. Overall, the authors suggest that the prevalence of the data was not homogeneous, however there was a trend towards a more pronounced rate of erosion in younger age groups. There was also a tendency for the onset of more erosive lesions with the increase of age. [24]

However one thing that Jensdottir [25] claims is certain, and that is that the erosive potential of food and drinks is a measure of its capacity to demineralise dental substances. Enamel erosion may take place if the pH is below 5.5. [20,21,22] In the study of Wang [147] of 2010 it is mentioned that at least one tooth surface had signs of erosion in 416 children (27.3%). Most commonly affected teeth were upper central and lateral incisors (16.3% and 15.9%) and less commonly affected were the lower (17.4% and 14.8%). Mostly affected areas were the incisal edges or occlusal surfaces (43.2%). Losing the contours of the enamel was present in 54.6% of the surface of the teeth. The results of the logistic regression analysis, showed, that children who were female, and consumed carbonated drinks once a week or more, and those whose mothers had a low level of education, were tending to have more erosive processes. The author offers a strategy for preventive health care, including multiple campaigns to promote a healthier lifestyle for those at risk of dental erosion.

The characteristics of food and beverages that affect their erosive potential include pH, titratic acidity, type of acid (pKa), calcium chelating properties, the concentration of inorganic elements (calcium, phosphate and fluoride), physical and chemical properties that influence the adherence to the enamel surface and stimulate salivary flow. [26] Many steps were taken on the composition of acid dietetic products, to reduce their erosive potential. This was achieved with the addition of compounds or mixtures of calcium and phosphate salts in the drinks and it has also been suggested to add citrate, acidifying of beverages or reduction of carbonation. These methods were used in order to have an effect on the taste and pH of the beverages, and the type of salt that was used was to alter the concentration. Adding calcium to the low pH of blackcurrant juice has been shown to have an impact on reducing the erosive power of the drinks. [26]

We want to mention the recommendations of Cowan [27], that could fit into a program of an effective health education on preventing dental erosion with a notice stating that dental professionals should be more active in the promotion of health when it comes to preventing dental erosion. The public and patients should be informed about dental implications of predisposing factors that cause erosion of the teeth. In addition, patients should be advised on how to prevent or minimize problems and the importance of full compliance with prevention policies. In conclusion we would say that the factors that provoke the emergence of dental erosions, the assessment of the extent of damage, treatment and preventive strategies can be single, reliable and straight, but a long way in preventing erosions or significantly slowing their progress and thereby preventing complications.

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