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Consumption of Carbonated and Fruit Drinks As A Risk Factor in The Onset of Dental Erosions in Examinees of Different Ages And Their Correlation to Salivary Calcium And Phosphates

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Abstract: *Taking into consideration the problem, which the patients face, with erosions of the teeth, our study is focused toward examining the consumption of carbonated and fruit drinks during the day, as a potential risk factor, in the development of erosive tissue, depending on the age of the patients, and salivary values of calcium and phosphates, and their association with the onset of dental erosions.*
In the presented distribution of data which take into consideration the consumption of carbonated drinks in the listed groups, for Pearson Chi-square=12,75and p<0,05(=0,047, there is a significant difference.
In the displayed distribution of information relating to the consumption of fruit juices in these groups the Pearson Chi-square = 16,19 and p <0,05 (p = 0,01) and there is no significant difference.
The average value of calcium (x=0,02mmol/l), in the group of examinees from 50 and > years, for p<0,05(p=0,04), is significantly lower, than, the average value of calcium (x=0,05mmol/l), in the control group.
For F=0,67 and p>0,05 (p=0,57) between the values of the phosphates in the saliva of the examinees from the examined groups, there is no significant difference.
From the presented results, we can see that between the average group values, of phosphates in the saliva of the examinees, p>0,05 and there is no significant difference between the groups.
We can conclude that future studies and discussions about the erosion of t teeth, and their role in the overall oral health, are necessary, but also, it seems that they are also stimulated because of their frequency.
Keywords: *dental erosions, fruit drinks, carbonated drinks, Ca, P*

I. Introduction

The dental erosions are defined as "loss of hard tissuesunder the influence of a chemical process, which does not include bacteria"[1]. That happens as a result of acids, and at the same time non saturation of the saliva with fluoride, which causes loss of hard tissue, layer by layer [2].The first dental erosion of the enamel does not cause a clinical change in terms of discoloration or softening of the tooth surface, and according to that, in this phase it is hard to detect the true clinical condition, using only visuo-tactile detection. Besides that, the symptoms in these patients, in these early phases very frequently are absent or are very limited.

The onset of this condition, was a subject of study, since the beginning of the 19th century[25], and since then, the incidence and prevalence of the dental erosions are more frequently the subject of studies carried out throughout the world.[3]

The prevalence of dental erosions are still not well documented and they occur very frequently in all societies and all ages, but still, today the abrasions of the teeth are a more frequent cause in adults [4,5].

Although the etiology of 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 on account of the unexplained dilemmas, we have to find out why some individuals have dental erosions while others don't, whilst being exposed to the same quantity of acid in the food and have a similar lifestyle, says Lussi [6].

However the most frequently mentioned factors are the consumption of acid foods and acid fruits (multiple times a day), general disorders in the diet, bruxism, stress, frequent vomiting, or ongoing or history of gastrointestinal reflux. There is no strong evidence towards the usual belief that bruxism is the main reason for the loss of the tooth structure. [7]

Today, the acids that are part of nonalcocholic beverages, for example Coca Cola is the most frequently named causative factor.The brushing of the teeth is the best way to conserve oral health, but afterwards the procedure for losing of the hard dental tissues is much faster and much greater in correlation to the erosion itself. Whitening toothpastes also increase the wasting of the dental enamel in eroded and in healthy dentine. [8]

The saliva controls the mineral equilibrium,and the mineral waste, during erosion in the oral cavity. The protective role of saliva in increased stimulation of salivary flow includes: cleaning with the saliva, the

ability to mitigate the acids, and the level of saturation of the teeth minerals. These benefices are increased when the saliva is stimulated after the ingestion of fermented carbohydrates and with the decrease in the pH of the saliva, which leads to the demineralization, while the reverse process increases the potential for remineralization.[9]

In the context of the before mentioned, our study is focused toward studying the consumption of carbonated and fruit drinks during the day as potential risk factors in the evolution of erosive tissue depending on the age of the patients, and also determining the concentration of Ca and phosphates in the saliva, in correlation to the consumption of different types of carbonated and fruit drinks.

II. Materials And Methods

The total sample consisted from 105 examinees divided into two groups: 1 - examinees from 10 to 29 years, 2 - examinees from 30 to 49 years and examinees from 50< years.The study was designed with the Clinical examinations end. Laboratory investigations

1. Clinical procedures

The diagnosing of dental erosion was made with visual exam and in the questionnaires we classified them according to the recommendations of Smith and Knight and later Millward et al.,

In the examination we used aStructuredquestionnaire.

It contained the habits of consuming soft 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

B. According to the respondents' answers about consuming fruit juices we made the notation as follows:

1 = rarely or never consuming fruit juices throughout the day

2 = those who consume fruit juices once a day

3 = those who consume fruit juices several times a day

Laboratory investigations

The assessment of the concentration of calcium and phosphates in the saliva was done using semiautomatic analyzers (Chem–5 Plus v2, Erba Diagnostics Manheim Gmbh, Germany) which function on the principle of atomic absorptive spectrometry.The data was noted, and analyzed with the help of the statistical package, version 10.5 - descriptive analysis including a mean value, standard deviation, percentage, Student's t test, correlation test (Spearman's Correlation) where the significance of the results was set at $p<0,05$.

III. Results

Between the listed groups for the Pearson Chi-square=1,19 and $p>0,05$ (=0,76) there is no significant difference in the frequency when the gender of the examinees is taken into consideration (table 1).

Table 1. Difference according to gender

	Group	Gender		Total
		Female	Male	
Count	Till 29 years	25	21	46
Total Percent		14,88%	12,50%	27,38%
Count	From 30-49 years	32	20	52
Total Percent		19,05%	11,90%	30,95%
Count	50 and>years	17	14	31
Total Percent		10,12%	8,33%	18,45%
Count	Control group	25	14	39
Total Percent		14,88%	8,33%	23,21%
Count	Total	99	69	168
Total Percent		58,93%	41,07%	

The data on table 2 presents the consumption of carbonated drinks in the listed examinee groups.

In the group of examinees *to 29 years,* 7(4,17%)examineesconsumed carbonated drinks with or without sugar 2 times a week or less, 24(14,29%) examinees consumed carbonated drinks with or without sugar 3-5 times weekly, and 15(8,93%) examinees consumed carbonated drinks with or without sugar 6 or more times a week.

In the group of examinees *from 30-49 years,* 9(5,36%) examinees consumed carbonated drinks with or without sugar 2 times a week or less, 34(20,24%) examinees consumed carbonated drinks with or without sugar 3-5 times weekly, and 9(5,36%) examinees consumed carbonated drinks with or without sugar 6 or more times weekly.

In the group of examinees *from 50 and > years*, 10(5,95%) examinees consumed carbonated drinks with or without sugar 2 times a week or less, 19(11,31%) examinees consumed carbonated drinks with or without sugar 3-5 times weekly, and 2(1,19%) examinees consumed carbonated drinks with or without sugar 6 or more times weekly.

Table 2.Consumption of carbonated drinks / Differences

	Group	Carbonated drinks			Total
		2 times weekly or less	3-5 times weekly	6 or more times weekly	
Count	Till 29 years	7	24	15	46
Total Percent		4,17%	14,29%	8,93%	27,38%
Count	From 30-49 years	9	34	9	52
Total Percent		5,36%	20,24%	5,36%	30,95%
Count	50 and>years	10	19	2	31
Total Percent		5,95%	11,31%	1,19%	18,45%
Count	Control group	8	18	13	39
Total Percent		4,76%	10,71%	7,74%	23,21%
Count	Total	34	95	39	168
Total Percent		20,24%	56,55%	23,21%	

In the presented distribution of data which takes into consideration the consumption of carbonated drinks in the mentioned groups for Pearson Chi-square=12,75 and p<0,05(=0,047) there is a significant difference.The data on table 3 represents the use of fruit drinks in the mentioned groups of examinees.

In the group of examinees to 29 years, 4(2,38%) examinees rarely or never consumed fruit drinks with or without sugar during the day, 11(6,55%) examinees consumed fruit drinks with or without sugar once during the day, and 31(18,45%) examinees consumed fruit drinks with or without sugar multiple times during the day.In the group of examinees from 30-49 years, 12(7,14%) examinees rarely or never consumed fruit drinks with or without sugar during the day, 19(11,31%) examinees consumed fruit drinks with or without sugar once during the day, and 21(12,50%) examinees consumed fruit drinks with or without sugar multiple times during the day.

In the group of examinees from 50 and > years, 12(7,14%) examinees rarely or never consumed fruit drinks with or without sugar during the day, 10(5,95%) examinees consumed fruit drinks with or without sugar once during the day, and 9(5,36%) examinees consumed fruit drinks with or without sugar multiple times during the day.

In the control group, 8(4,76%) examinees rarely or never consumed fruit drinks with or without sugar during the day, 14(8,33%) examinees consumed fruit drinks with or without sugar once during the day, and 17(10,12%) examinees consumed fruit drinks with or without sugar multiple times during the day.

In the presented distribution of data which takes into consideration the consumption of fruit drinks in the mentioned groups, for the Pearson Chi-square=16,19 and p<0,05 (p=0,01) there is a significant difference.

Table 3. Consumption of fruit drinks / Differences

	Group	Fruit drinks			Total
		Rarely Or never	Once during The day	Multiple times during The day	
Count	Till 29 years	4	11	31	46
Total Percent		2,38%	6,55%	18,45%	27,38%
Count	from 30-49 years	12	19	21	52
Total Percent		7,14%	11,31%	12,50%	30,95%
Count	50 and>years	12	10	9	31
Total Percent		7,14%	5,95%	5,36%	18,45%
Count	Control group	8	14	17	39
Total Percent		4,76%	8,33%	10,12%	23,21%
Count	Total	36	54	78	168
Total Percent		21,43%	32,14%	46,43%	

For F=2,90 and p<0,05 (p=0,04) between the values of calcium in the saliva of examinees from the examined group there is a significant difference (table 4).

Table 4. Calcium / Difference

Parameter	SS Effect	Df Effect	MS Effect	SS Error	Df Error	MS Error	F	p
Calcium	0,03	3	0,01	0,66	164	0,004	2,90	**0,04**

The data on table 5 present the differences between the groups and their different values of calcium in the saliva.The average value of calcium (x=0,05 mmol/l) in the group of examinees to 29 years, p<0,05(p=0,04) and it is significantly greater than the average value of calcium (x=0,03mmol/l), in the group of examinees from 30-49 years; for p<0,05(p=0,04) it is significantly greater than the average value of calcium (x=0,02mmol/l) in the group of examinees 50 and > years; for p>0,05(p=0,86) there is no significant difference in comparison to the average value of calcium (x=0,05mmol/l) in the control group. The average value of calcium (x=0,03mmol/l) in the group of examinees from 30-49 years for p>0,05 (p=0,82) is insignificantly greater than the average value of calcium (x=0,02 mmol/l) in the group of examinees from 50 and > years; for p<0,05 (p=0,03) it is significantly less than the average value of calcium (x=0,05mmol/l) in the control group.
The average value of calcium (x=0,02mmol/l) in the group of examinees from 50 and > years for p<0,05(p=0,04) it is significantly less than the average value of calcium (x=0,05 mmol/l) in the control group.
Table 5. Calcium / Post hoc/ LSD Test

Group	{1} M=0,05	{2} M=0,03	{3} M=0,02	{4} M=0,05
Till 29 years {1}		**0,04**	**0,04**	0,86
From 30-49 years {2}	**0,04**		0,82	**0,03**
50 and>years {3}	**0,04**	0,82		**0,04**
Control group{4}	0,86	**0,03**	**0,04**	

For F=0,67 and p>0,05(p=0,57), between the values of phosphates in the saliva of examinees from the examined groups there is no significant difference (table 6).
Table 6. Phosphates / Differences

Parameter	SS Effect	Df Effect	MS Effect	SS Error	Df Error	MS Error	F	p
Calcium	0,019899	3	0,01	1,61	164	0,01	0,67	0,57

The data on table 7 presents the differences between the groups and their different values of phosphates in the saliva.From the presented results we can see that between the average group values of phosphates in the saliva of examinees for p>0,05 there is no significant difference.

Phosphates / Post hoc / LSD Test

Group	{1} M=0,37	{2} M=0,37	{3} M=0,39	{4} M=0,39
Till 29 years{1}		0,72	0,55	0,36
From30-49 years {2}	0,72		0,35	0,20
50 and>years {3}	0,55	0,35		0,80
Control group {4}	0,36	0,20	0,80	

IV. Discussion

The clinical studies show that carbonated drinks, particularly the carbonated drink Coca Cola, are closely associated with the onset of dental erosions, probably because of their low pH value.[94] Still, the In vitro studies show that fruit drinks can also be potential erosive factors, because of their high concentration of titratic acid [10]The results from our study show that the greatest number of examinees consumed carbonated drinks 3-5 times daily, and the greatest part of them were male, and the consumption of fruit drinks was present in both male and female examinees.

The study showed that there is a positive correlation between dental erosions, consumption of carbonated drinks and fruit drinks, and between the total sample of examinees with dental erosions, and between dental erosions and all age groups of examinees (p>0,05) and for the male and female examinees which concerns the consumption of carbonated drinks and fruit drinks (p>0.00).In the presented distribution of data which concerns the consumption of carbonated drinks in the mentioned groups, for the Pearson Chi-square=12,75 and p<0,05(=0,047) there is a significant difference.In the presented distribution of data which concerns the consumption of fruit drinks in the mentioned groups for the Pearson Chi-square=16,19 and p<0,05(p=0,01) there is a significant difference.The goal of the study carried out by Van't Spijker[11]wasto get data about the presence of dental erosions in adults, and to assess the opportunity to search the literature, for which they used PubMed and Cochrane Library, from January 1980 to July 2007. The results were noted according to the indexes which were offered by Smith and Night. The results showed that there is an increase in the % of erosions according to age, i.e. it is 3% at the age of 20 and 17% at the age of 70.The non-organic components of the saliva are most commonly the salivary cations like Ca, Na, K and anions such as chlorides, fluorides, phosphates, sulphates, carbonates, nitrates, and similar.

The human salivary secretions, according Hay [12], are full of calcium and phosphate, but spontaneous precipitations from the saliva on the dental enamel normally does not appear. This unexpected stability is mediated by a group of salivary proteins such as, staterin, acidic PRPs, cystatin and histatins. These proteins are distinguished from other salivary defense proteins by that, that they have a specific function only for the oral environment, ie. maintaining homeostasis when there is oversaturation of the saliva, and these proteins are multifunctional, in that they are partly responsible for the capacity of remineralization of the saliva, but also interact with some microorganisms [13].

Of particular interest are the Ca and phosphate ions in the saliva, because of their specific relationship to dental substances. Salivary phosphates have an important anticariogenic role with its participation in the composition ofthe salivary buffering systems, then maintaining the stability of the mineral content of teeth in the process of demineralization and remineralization. [13]

For the average value of calcium (x=0,02mmol/l) in the group *of examinees from 50 and > years*, for p<0,05(p=0,04) it is significantly less than the average value of calcium (x=0,05mmol/l) in the control group.

For F=0,67 and p>0,05(p=0,57) between the values of phosphates in the saliva of examinees from the examined groups there is no significant difference.The data in Table 33.1 relate to intergroup differences of values of phosphate in the saliva of examinees.From the presented results we can see that between the group average values of phosphates in the saliva of examinees for p>0,05 there is no significant intergroup difference.Between the consumption of fruit drinks and the average value of calcium and phosphates in the saliva, for p>0,05 there is a weak positive insignificant correlation, and for p<0,05 for phosphates there is a very weak insignificant negative correlation. Namely, the increased use of fruit drinks increases the values of calcium in the saliva and the increased use of fruit drinks is followed by a decrease in the values of phosphates in examinees at the age from 30-49 years and 50 and > years.

The reduction of Ca and Mg ions in saliva is highly dependent on the increase in salivary flow. Calcium and phosphate are among the main non-organic ingredients, involved in maintaining the structure of the teeth. [15]An important fact for the dental erosion is that salivary calcium, by diffusion can be incorporated into the organic matrix of the plaque. It is experimentally established, that dental plaque contains inhibitors of deposition of calcium phosphate. [16] The mechanisms that regulates the salivary deposition of calcium and phosphate ions, are directly dependent on the pH of saliva. [17] Critical pH occurs when the saliva is not oversaturated with calcium ions and phosphates and enamel becomes porous.

A significant reduction in local pH changes the chemical balance of the tooth surface, increases the solubility of hydroxyl apatite and the saturation of saliva with calcium ions, phosphates and bicarbonates decreases for about 10 to 30%, leading to the disappearance of macromolecular organic compounds. [18].

Knowing the factors that provoke the emergence of dental erosion, the assessment of the extent of damage, treatment and preventive strategies can be a single, reliable and straight, but a long way, in preventing erosion, or significantly slowing their progress and thereby prevent complications.In conclusion, we would say that the comparison of the results we got from our study are almost impossible to fully compare to the results of many studies that were available, because of the forming of uneven age groups, the use of different systems to assess the existence and extent of dental erosions, and of course the small sample size.

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