

RELATIONSHIP BETWEEN DENTAL EROSION
AND BEVERAGE CONSUMPTION PATTERN
IN OVERWEIGHT AND OBESE PATIENTS

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Abstract

This study aims to investigate the relationship between dental erosion and frequency of non-alcoholic beverage intake in normal-weight, overweight, and obese individuals.

The study involved 264 subjects aged 18–60 years with normal weight (control group), overweight and obesity. The frequency of non-alcoholic beverage intake has been assessed. The grade of erosive tooth wear has been measured using the BEWE index (Basic Erosive Wear Examination). When comparing the control and overweight groups, a statistically significant difference has been found between the group with no erosive wear, score 0, and the one with initial enamel surface loss, score 1, ($\chi^2 = 18.633$, $p < 0.05$). When comparing the control and obese groups, a significant difference has been found between the groups with score 0 ($\chi^2 = 19.179$, $p < 0.05$), score 2 ($\chi^2 = 0.160$, $p < 0.05$) and score 3 ($\chi^2 = 0.160$, $p < 0.05$), as well as when comparing the subjects in the control group with score 0 by sex ($\chi^2 = 3.360$, $p < 0.05$). The Kruskal–Wallis test has indicated a statistically significant difference among the three studied groups depending on body weight (BMI), ($\chi^2 = 19.036$, $p < 0.001$), as well as on the non-alcoholic beverage consumption in the individuals affected by erosive

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wear ($\chi^2 = 57.403$, $p < 0.001$). A relationship between the frequency of intake related to these beverages and the dental erosive wear has been established.

Key words: overweight, obesity, non-alcoholic beverages, Basic Erosive Wear Examination

Introduction. Over the last decade, dental erosion has become a serious challenge for dental professionals. It was identified as an emerging problem for the first time about 25 years ago. Since then, its prevalence has been dramatically increasing in children, adolescents and adults. Dental erosion is defined as the loss of dental hard tissue resulting from its exposure to exogenous and endogenous acids not involving acids of bacterial origin [1,2]. In most cases, erosive tooth wear (ETW) is a general term which includes: abrasion (physical wear originating from mechanical forces from foreign elements); attrition (physical wear, caused by the effect of antagonist tooth contact without participation of foreign elements); abfraction (physical wear due to compressive and tensile stress in the cervical region when a tooth experiences flexing or bending during the chewing process, provoking microfractures in the enamel and dentine); and erosion (chemical wear, as a result of exogenous or endogenous acids or chelators acting on plaque-free tooth surfaces) [1-3]. The three processes often occur simultaneously, as the interaction between abrasion and attrition, potentiated by dental erosion, plays the most important role in the destruction of hard dental tissues in adult patients [4].

The aim of this study is to investigate the relationship between dental erosion and frequency of non-alcoholic beverage intake in normal-weight, overweight, and obese individuals.

Material and methods. The study group consisted of 264 individuals – 109 men and 155 women from the city of Sofia aged 18–60 years. Of these 72 subjects with normal body weight, as a control group ($\text{BMI} = 18.5\text{--}24.9 \text{ kg/m}^2$), and 192 subjects, 65 of whom with overweight ($\text{BMI} = 25.0\text{--}29.9 \text{ kg/m}^2$) and 127 – with obesity ($\text{BMI} > 30.0 \text{ kg/m}^2$). Patients with gastroesophageal reflux disease (GERD) have been excluded from the study.

The frequency of non-alcoholic beverage consumption has been assessed considering the information obtained from their food diaries – less than or once a week, 2 to 6 times a week, once or more than once a day, never. To assess the degree of erosive wear, the BEWE index (Basic Erosive Wear Examination) [5] has been used, in which the tooth row is divided into six separate sextants: (17–14), (13–23), (24–27), (37–34), (33–43), (44–47). The assessment has been carried out on the basis of the following scoring system: **Score 0** – No erosive tooth wear; **Score 1** – Initial loss of enamel structure; **Score 2** – Distinct defect, hard tissue (dentine) loss $< 50\%$ of the surface area; **Score 3** – Hard tissue (dentine) loss $\geq 50\%$ of the surface area.

Statistical analysis. All statistical analyses have been carried out using SPSS® v.20.0 statistical software (IBM, Armonk, NY). Differences between groups

have been analyzed using Mann–Whitney U-test, Kruskal–Wallis H test, *chi*-square test or Fisher’s exact test. Differences have been considered statistically significant at the $p < 0.05$ level.

Results. We have conducted a study on the erosive wear of dental structures in the subjects of our study with overweight and obesity, as the results have been compared with those of the control group.

T a b l e 1
BEWE in normal-weight and overweight subjects

Indicators	Total number of subjects $n = 137$				χ^2 p value
	Control group ($n = 72$)		Overweight ($n = 65$)		
BEWE Basic Erosive Wear Examination	Men ($n = 19$)	Women ($n = 53$)	Men ($n = 22$)	Women ($n = 43$)	
Score 0	42.1% (8)	67.9% (36)	45.4% (10)	11.6% (5)	
No erosive tooth wear	$\chi^2 = 3.912, p < 0.05$		$\chi^2 = 7.572, p < 0.05$		
Total	61.1% (44)		23.1 % (15)		$\chi^2 = 18.633,$ $p < 0.05$
Score 1	26.3% (5)	18.9% (10)	40.9% (9)	37.3% (16)	
Initial loss of enamel structure	$\chi^2 = 0.127, p > 0.05$		$\chi^2 = 0.004, p > 0.05$		
Total	20.9% (15)		38.5% (25)		$\chi^2 = 4.317,$ $p < 0.05$
Score 2	21.1% (4)	11.3% (6)	9.1% (2)	30.2% (13)	
Distinct defect, hard tissue (dentine) loss <50% of the surface area	$\chi^2 = 0.443, p > 0.05$		$\chi^2 = 2.570, p > 0.05$		
Total	13.8% (10)		23.1 % (15)		$\chi^2 = 1.366,$ $p > 0.05$
Score 3	10.5% (2)	1.9% (1)	4.6% (1)	20.9% (9)	
Hard tissue (dentine) loss $\geq 50\%$ of the surface area	$\chi^2 = 0.898, p > 0.05$		$\chi^2 = 1.874, p < 0.05$		
Total	4.2% (3)		15.3% (10)		$\chi^2 = 3.784,$ $p > 0.05$

The results obtained related to erosive wear in the control group and the overweight group and their comparison by sex within groups and between groups are presented in Table 1. A statistically significant difference between the group with no erosive wear – score 0, and the group with initial loss of enamel structure – score 1 ($\chi^2 = 18.633, p < 0.05$) has been reported. In the intragroup comparison of the results by sex, the reliability of the results in the control group with no erosive wear of the teeth – score 0 ($\chi^2 = 3.912, p < 0.05$) and in the overweight

group – score 0 ($\chi^2 = 7.572$, $p < 0.05$) and score 3 ($\chi^2 = 1.874$, $p < 0.05$) has been proven. It is notable that the relative share of subjects from the two groups affected by erosive wear with dentine involvement is small – score 2 and score 3.

T a b l e 2
BEWE in normal-weight and obese subjects

Indicators	Total number of subjects $n = 199$				χ^2 p value
	Control group ($n = 72$)		Overweight ($n = 127$)		
BEWE Basic Erosive Wear Examination	Men ($n = 19$)	Women ($n = 53$)	Men ($n = 68$)	Women ($n = 59$)	
Score 0	42.1% (8)	67.9% (36)	25% (17)	32.2% (19)	
No erosive tooth wear	$\chi^2 = 2.912, p < 0.05$		$\chi^2 = 0.491, p > 0.05$		
Total	61.1% (44)		28.3 % (36)		$\chi^2 = 19.179,$ $p < 0.05$
Score 1	26.3% (5)	18.9% (10)	27.9% (19)	20.3% (12)	
Initial loss of enamel structure	$\chi^2 = 0.127, p > 0.05$		$\chi^2 = 0.620, p > 0.05$		
Total	20.9% (15)		24.4% (31)		$\chi^2 = 0.160,$ $p > 0.05$
Score 2	21.1% (4)	11.3% (6)	36.8% (25)	30.6% (18)	
Distinct defect, hard tissue (dentine) loss <50% of the surface area	$\chi^2 = 0.443, p > 0.05$		$\chi^2 = 0.308, p > 0.05$		
Total	13.8% (10)		33.9 % (43)		$\chi^2 = 8.383,$ $p < 0.05$
Score 3	10.5% (2)	1.9% (1)	10.3% (7)	16.9% (10)	
Hard tissue (dentine) loss $\geq 50\%$ of the surface area	$\chi^2 = 0.898, p > 0.05$		$\chi^2 = 0.092, p > 0.05$		
Total	4.2% (3)		13.4% (17)		$\chi^2 = 3.360,$ $p < 0.05$

Table 2 demonstrates the results when comparing the data related to erosive wear in subjects from the control group and those with obesity, establishing a statistically significant difference between the groups with score 0 ($\chi^2 = 19.179$, $p < 0.05$), score 2 ($\chi^2 = 0.160$, $p < 0.05$), and score 3 ($\chi^2 = 0.160$, $p < 0.05$), as well as when comparing by sex the subjects in the control group with score 0 ($\chi^2 = 3.360$, $p < 0.05$).

The beverage consumption pattern of the individuals we have studied included mainly soda, fruit juices, energy drinks, sport drinks. They prefer consuming especially soft drinks (95%), fruit juices (79%), whereas the relative shares of other drinks (energy drinks (43%) and sport drinks (23%)) are significantly

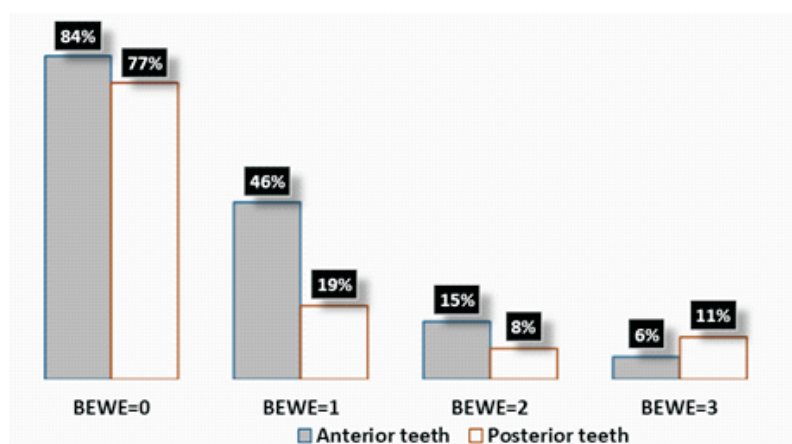


Fig. 1. BEWE – index by affected teeth

smaller, however, the subjects prefer consuming them as well. Only 3% of participants did not consume any beverages.

Figure 1 illustrates the BEWE index values related to affected teeth in the subjects. The results show that the anterior teeth are mostly affected, whereas the posterior teeth are less affected.

T a b l e 3

Consumption of non-alcoholic beverages and dental erosion

Indicators	Affected by erosion <i>n</i>	Affected by erosion %	<i>p</i> value	
			Kruskal–Wallis H test	Mann–Whitney U test
BMI			H = 19.036 <i>p</i> < 0.001	
A. Normal weight (72)	28	38.9%		A-B* <i>z</i> = 3.834, <i>p</i> = 0.0001
B. Overweight (65)	50	76.9%		A-C* <i>z</i> = 3.835, <i>p</i> = 0.0001
C. Obesity (127)	91	71.7%		B-C <i>z</i> = 0.595, <i>p</i> = 0.548
Non-alcoholic beverage consumption			H = 57.403 <i>p</i> < 0.001	A-B <i>z</i> = 1.169, <i>p</i> = 0.242
A. ≤ once a week (38)	29	76.3%		A-C* <i>z</i> = 3.253, <i>p</i> = 0.001
B. 2–6 times a week (110)	97	88.2%		A-D* <i>z</i> = 4.211, <i>p</i> < 0.0001
C. ≥ once a day (96)	41	42.7%		B-C* <i>z</i> = 6.063, <i>p</i> < .0001
D. never (20)	2	10.0%		B-D* <i>z</i> = 5.622, <i>p</i> < 0.0001 C-D* <i>z</i> = 5.762, <i>p</i> < 0.0001

When comparing the subjects affected by erosive wear, it has been established that the Kruskal–Wallis test shows a statistically significant difference among the three studied groups depending on body weight (BMI), ($\chi^2 = 19.036$, *p* < 0.001). A statistically significant difference has been also found in the consumption of

non-alcoholic beverages in the subjects affected by erosive wear ($\chi^2 = 57.403$, $p < 0.001$).

Mann–Whitney test results have demonstrated that there is a statistically significant difference in erosive wear between normal-weight and overweight subjects ($z = 3.834$, $p = 0.0001$) as well as between obese and normal-weight subjects ($z = 3.835$, $p = 0.0001$). No significant difference related to erosive wear has been found between obese and overweight subjects ($z = 0.595$, $p = 0.548$).

Regarding the frequency of non-alcoholic beverage consumption and erosive wear, a lack of statistically significant difference has been found only between the groups with frequency of consumption once a week and 2–6 times a week ($z = 1.169$, $p = 0.242$).

Discussion. The changes in the modern lifestyle and eating habits studied in recent years have revealed an increase in the number of individuals diagnosed with health conditions such as obesity, type 2 diabetes, dental caries and dental erosion. Diet is the most frequently investigated risk factor for erosive wear of hard dental structures. Several researches have shown that consumption of non-alcoholic high-sugar-and-acid-content beverages may contribute to development of overweight, obesity, type 2 diabetes, dental caries and dental erosion [6]. The role of the vegetarian diet in the erosive wear of the teeth is also indicated [7].

According to the 2016 Annual Report of the British Non-alcoholic Beverages Association, non-alcoholic beverages cover both soft and sweetened drinks, fruit juices, sports and energy drinks [8]. Some of the reports indicate their harmful effects on dental and general health in children, adolescents and adults [9]. Non-alcoholic beverages have many potential health problems, including dental caries and enamel erosion [10,11]. The high content of sugar and acids, having cariogenic and acidogenic potential, can lead to dental caries, tooth erosion, as well as to development of overweight, obesity and a high risk of type 2 diabetes [9].

Other drinks that are very popular with young people are sports drinks, also known as electrolyte drinks. They contain water, carbohydrates, mainly glucose, maltodextrin, fructose, and electrolytes such as sodium, potassium, and chloride [12]. In recent years, the preferred energy drinks contain a large amount of sugar and caffeine, guarana, taurine and ginseng [13]. All these drinks have a negative impact on dental health [12]. They contain large amounts of sucrose or high fructose corn syrup and have a high cariogenic potential. Their frequent consumption can cause dental caries, as the greatest risk occurs when they are consumed between meals and not with food.

Most non-alcoholic beverages have a pH of 2.5 to 3.5 with an average pH of 3.44 for soft drinks and fruit juices [14]. They also contain acids – carbonic acid, phosphoric acid, malic acid and citric acid, having erosive potential [15]. Most researchers indicate that their consumption has a significant relationship with dental erosion [16].

Erosion of hard dental structures can lead to severe loss of tooth surface, resulting in increased tooth sensitivity and eating and drinking difficulties, as well as impaired esthetics [17]. Frequent consumption of non-alcoholic beverages such as sweetened beverages, soft drinks and fruit juices has been shown to increase the incidence of dental erosion [10], which is also confirmed by our results.

In order to limit the growth of dental erosion cases, the WHO and the Food and Agricultural Organization of the United Nations recommend, within the framework of the published Global Strategy on Diet, Physical Activity and Health – 2004, reducing the amount and frequency of intake related to the non-alcoholic beverages and fruit juices [18].

Obesity is a fundamental global health problem according to the World Health Organization (WHO) and the Scientific Advisory Committee on Nutrition (SACN) [19]. Increased consumption of non-alcoholic beverages has been reported to be a major factor in the epidemic of overweight, obesity and diabetes [19].

To prevent future progression of this non-carious tooth condition, it should be diagnosed as early as possible. Regarding the diet, the preventive measures include primarily reducing the amount and frequency of consumption of erosive beverages and of sweet and sour foods [20].

Conclusion. Non-alcoholic beverages have caused erosive wear of hard dental structures in overweight and obese subjects, as well as in half of normal-weight controls. An association between the frequent intake of these beverages and the erosive tooth wear has been established.

Further studies in this regard are needed, since the current study is the first one related to this topic in our country.

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