

## ORAL HEALTH-RELATED QUALITY OF LIFE AND RISK FACTORS IN PATIENTS WITH TOOTH WEAR

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### Abstract

**Objective:** The aim of this study was to determine the association between the degree of erosive tooth wear, measured by Basic Erosive Wear Examination (BEWE) index, and daily habits and behavior, quality of life and psychosocial conditions related to oral health.

**Material and method:** The study included 259 participants aged between 35 and 65 years, divided into three groups according to the degree of tooth wear: 1. patients with diagnosed non-carious lesions with BEWE stage 2, 2. patients with BEWE stage 3 and 3. control group - persons without erosive or other forms of oral pathology. Data collection was carried out during routine dental visits in 2025 at the University Dental Clinical Center "St. Panteleimon" in Skopje. After the dental examination, participants were asked to complete three questionnaires: the OHIP-MAK-14 structured questionnaire, which is used to measure oral health-related quality of life (OHRQoL), the Disease Behavior and Knowledge Questionnaire, and the Perceived Stress Scale (PSS). All data were then analyzed using the Statistical Package for the Social Sciences (SPSS), version 26.

**Results:** Patients with more severe erosion reported greater consumption of certain acidic products, especially alcoholic beverages and lozenges, with the difference that the BEWE 3 group consumed more alcohol, while the BEWE 2 group consumed more lozenges. The patients' awareness of erosive lesions was highest in the BEWE 2 category and lowest in the control group. Oral hygiene maintenance was the weakest in the severe erosion group, and when choosing a toothbrush, especially the use of hard brushes, it was more common in patients with erosive lesions. Patients with a higher degree of erosion than BEWE stage 3 had a higher prevalence of bruxism, higher perceived stress and poorer oral health-related quality of life. These results highlight a clear trend: as the severity of erosive lesions increases, so does the reported effect on quality of life. The present findings indicate a consistent and significant association between the severity of erosive tooth wear, as measured by the BEWE, and a wide range of behavioral, psychosocial, and oral health-related outcomes.

**Conclusion:** All dietary and behavioral factors showed clear gradients consistent with erosion severity, suggesting that erosive tooth wear is multifactorial and not attributable to a single dietary or behavioral source. Future studies should aim to include more respondents, preferably with age-balanced subgroups.

**Key words:** non-carious dental damage, risk factors, quality of life, public health in dentistry

### Introduction

Teeth undergo various forms of physical and chemical damage throughout life, leading to their wear [1]. Erosive tooth wear (ETW) is defined as a chemical–mechanical process that results in a cumulative loss of mineralized dental tissue not caused by bacteria [2].

To prevent the development of erosive tooth wear, which is a multifactorial disorder, it is crucial to identify patients at risk and evaluate potential risk factors. The risk factors that have been studied include

sociodemographic, socioeconomics, general health, oral diseases, medication, oral hygiene, food, beverages, and dietary habits [3].

The irreversible and multifactorial aspects of non-carious tooth damage make it one of the most difficult dental problems to manage, therefore early diagnosis of pathological forms of tooth wear is very important [4].

Several methods have been described in the literature to diagnose and classify non-cariogenic tooth wear, and these can generally be divided into quantitative and qualitative. Quantitative methods are based on objective physical measurements of the depth and side of the tooth defect, as well as the height of the crown, while qualitative methods are based on clinical description and can be more subjective [5].

From an epidemiological point of view, there is a need to record the presence and degree of tooth wear or, more precisely, the clinical finding imposes the need to use an index to assess the level of tooth damage. The BEWE index (Basic Erosive Wear Examination) is a practical index for screening and assessing erosive tooth wear, using a 4-point scale. It can be used at the individual and/or epidemiological level [6].

The BEWE is primarily designed to assess erosive tooth wear and is suitable for conducting epidemiological studies.

Many epidemiological studies have been devoted to investigating the prevalence and underlying factors contributing to occlusal deformation of teeth in the adult population [7,8]. The prevalence of dentin exposure due to erosion has been reported to be 23.4% in Germany [9].

In the Japanese population, 26.1% of 1,088 individuals aged 15 to 89 years showed signs of erosive wear [10].

Significant risk factors for erosion include age and frequency of tooth brushing, as demonstrated in a study conducted in China [11]. The use of dental abrasives, dust exposure, frequency and technique of tooth brushing, and unilateral chewing were identified as risk factors contributing to erosion [12].

With a thorough clinical examination and accurate history, various risk factors associated with erosion can be identified and strategies to reduce or eliminate these factors can be identified.

Therefore, the aim of this study was to determine the association between the degree of erosive tooth wear, as measured by BEWE, and daily habits and behaviors, quality of life, and psychosocial conditions related to oral health. Using this knowledge, experts and public health professionals will be equipped to establish protocols and develop preventive strategies for passive management of tooth wear.

### **Material and methods**

The study was conducted on a convenience sample comprising 259 participants aged between 35 and 65 years ( $M = 51.08$ ,  $SD = 9.43$ ). The patients divided into three groups according to the degree of tooth wear: I. 104 patient with diagnosed non-carious lesions corresponding to BEWE stage 2, II. 103 patients with more advanced non-carious lesions classified as BEWE stage 3 and III. control group - 56 persons without erosive or other forms of oral pathology.

Notable age differences were observed between the study groups. Participants without erosive lesions were, on average, considerably younger ( $M = 43.40$  years) compared to those diagnosed with BEWE stage 2 ( $M = 50.63$  years) and BEWE stage 3 erosive lesions ( $M = 55.41$  years).

These differences are relevant, as age may be associated with cumulative exposure to risk factors for erosive tooth wear, as well as with variations in health-related behaviors and access to dental care.

Data collection was conducted during routine dental examinations in 2025 at the University Dental Clinical Center "St. Panteleimon" in Skopje. Patients were informed of the study objectives and written informed consent was obtained before inclusion in the study. The study protocol was reviewed and approved by the relevant institutional ethics committee, and all procedures were conducted in accordance with established ethical standards and the principles of the Declaration of Helsinki.

The study assessed the degree of erosive changes using the BEWE index. Non-carious tooth damage were assessed based on clinical examinations and recorded using the method of Dixon B et al.(13).

After the dental examination, participants were asked to complete three questionnaires: the OHIP-MAK-14 structured questionnaire, which is used to measure oral health-related quality of life (OHRQoL), the Disease Behavior and Knowledge Questionnaire, and the Perceived Stress Scale (PSS). All data were then analyzed using the Statistical Package for the Social Sciences (SPSS), version 26.

**RESULTS**

Responses were obtained from the patients on several aspects of their lives, including: frequency of consumption of acidic foods or beverages, their knowledge of risk factors and methods of erosive tooth wear, attitude towards visiting the dentist and maintaining oral hygiene, as well as the presence of stress, oral health-related quality of life.

The descriptive data on patients’ habits across the different categories show that the averages vary, especially for the group without BEWE scores, although these differences are not very large (Table1 and 1a). A more noticeable difference appears for alcoholic beverages and non-carbonated drinks in the group of non-carious patients without BEWE, which could very likely be attributed to the age of this subgroup in the sample. Interestingly, other types of acidic products are not highly represented in the patients’ diet.

**Table 1.** Consumption of acidic food and drinks among patients with different BEWE categories- Descriptives

		N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
						Lower Bound	Upper Bound		
Carbonate drinks	0	52	3.85	2.845	.395	3.05	4.64	0	9
	2	104	.98	1.238	.121	.74	1.22	0	4
	3	103	2.10	2.673	.263	1.57	2.62	0	10
	Total	259	2.00	2.479	.154	1.70	2.30	0	10
Vine and spirits	0	52	5.12	3.027	.420	4.27	5.96	0	10
	2	104	2.55	1.980	.194	2.16	2.93	0	9
	3	103	3.81	3.046	.300	3.21	4.40	0	10
	Total	259	3.56	2.823	.175	3.22	3.91	0	10
Citrus fruits (pieces)	0	52	3.04	2.910	.404	2.23	3.85	0	9
	2	104	4.13	2.644	.259	3.62	4.65	0	10
	3	103	3.89	2.890	.285	3.33	4.46	0	10
	Total	259	3.82	2.816	.175	3.47	4.16	0	10
Sour candies	0	52	.52	.980	.136	.25	.79	0	4
	2	104	1.60	1.586	.156	1.29	1.90	0	9
	3	103	1.69	1.961	.193	1.31	2.07	0	8
	Total	259	1.42	1.708	.106	1.21	1.63	0	9
Lozenges	0	52	.94	1.145	.159	.62	1.26	0	5
	2	104	2.65	1.889	.185	2.29	3.02	0	7
	3	103	1.62	1.663	.164	1.30	1.95	0	9
	Total	259	1.90	1.795	.112	1.68	2.12	0	9

Note. BEWE groups: 0 = patients without erosion, 2 = patients with BEWE 2 stage erosions, 3 = patients with BEWE 3 stage erosions.

**Table 1a.** Consumption of acidic food and drinks among patients with different BEWE categories- One way ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
Carbonate drinks	Between Groups	286.240	2	143.120	28.189	.000
	Within Groups	1299.760	256	5.077		
	Total	1586.000	258			
Vine and spirits	Between Groups	238.515	2	119.258	16.801	.000
	Within Groups	1817.184	256	7.098		
	Total	2055.699	258			
Citrus fruits (pieces)	Between Groups	42.607	2	21.304	2.722	.068
	Within Groups	2003.864	256	7.828		
	Total	2046.471	258			
Sour candies	Between Groups	52.888	2	26.444	9.670	.000
	Within Groups	700.077	256	2.735		
	Total	752.965	258			
Lozenges	Between Groups	114.792	2	57.396	20.504	.000
	Within Groups	716.598	256	2.799		
	Total	831.390	258			

*Note.* BEWE groups: 0 = patients without erosions, 2 = patients with BEWE 2 stage erosions, 3 = patients with BEWE 3 stage erosions.

Statistical analysis of the differences between groups showed that only in the case of citrus fruits there was no significant difference. For our analysis, the differences between patients with different BEWE levels were of particular interest. Statistically significant differences between patients with BEWE 3 and BEWE 2 only appeared in the consumption of alcoholic beverages and golf tablets.

However, the differences did not appear in the same direction. On average, the BEWE 3 group consumed more alcohol, while the BEWE 2 group consumed more golf tablets.

Data regarding patients' knowledge of erosive tooth wear is presented in Table 2. When asked "Have you ever heard of acid-related tooth damage?", participants answered either yes or no. Table 2 shows which group was the most informed. The highest percentage of informed patients was observed in the BEWE 2 category, followed by BEWE 3, and then in patients without erosions.

**Table 2.** Have you ever heard about acid-related tooth damage?

			NO	YES	Total
BEWE	0	Count	28	24	52
		% within BEWE	53.8%	46.2%	100.0%
	2	Count	24	80	104
		% within BEWE	23.1%	76.9%	100.0%
	3	Count	45	58	103
		% within BEWE	43.7%	56.3%	100.0%
Total		Count	97	162	259
		% within BEWE	37.5%	62.5%	100.0%

Note. BEWE groups: 0 = patients without erosions, 2 = patients with BEWE 2 stage erosions, 3 = patients with BEWE 3 stage erosions.

The responses to the question ‘Do you think that good oral hygiene can prevent such acid-related damage?’ are presented in Table 3. The largest proportion of respondents across all categories agree that good oral hygiene reduces the problem of erosions.

**Table 3.** Do you think that good oral hygiene can prevent such acid-related damage?

			NO	YES	Don't know	Total
BEWE	0	Count	14	23	15	52
		% within BEWE	26.9%	44.2%	28.8%	100.0%
	2	Count	20	57	27	104
		% within BEWE	19.2%	54.8%	26.0%	100.0%
	3	Count	4	53	46	103
		% within BEWE	3.9%	51.5%	44.7%	100.0%
Total		Count	38	133	88	259
		% within BEWE	14.7%	51.4%	34.0%	100.0%

Note. BEWE groups: 0 = patients without erosions, 2 = patients with BEWE 2 stage erosions, 3 = patients with BEWE 3 stage erosions.

The following tables show the attitude towards maintaining oral hygiene, as well as visiting a dentist.

Clear differences emerged between the BEWE groups regarding the time since the last dental visit (Table 4). Patients without erosions (BEWE 0) most frequently reported dental visits within the past year, while those with the most severe erosions (BEWE 3) were more likely to have gone more than 24 months without a dental visit. The BEWE 2 group showed a more even distribution across the categories.

**Table 4.** How long has it been since your last dental visit?

		0-6 months	7-12 months	13-24 months	More than 24 months	no data	Total
BEWE 0	Count	19	30	3	0	0	52
	% within BEWE	36.5%	57.7%	5.8%	0.0%	0.0%	100.0%
2	Count	31	32	36	5	0	104
	% within BEWE	29.8%	30.8%	34.6%	4.8%	0.0%	100.0%
3	Count	4	3	22	38	36	103
	% within BEWE	3.9%	2.9%	21.4%	36.9%	35.0%	100.0%
Total	Count	54	65	61	43	36	259
	% within BEWE	20.8%	25.1%	23.6%	16.6%	13.9%	100.0%

Note. BEWE groups: 0 = patients without erosions, 2 = patients with BEWE 2 stage erosions, 3 = patients with BEWE 3 stage erosions.

The frequency of tooth brushing varied notably across BEWE groups (Table 5). Patients without erosions (BEWE 0) and those with moderate erosions (BEWE 2) reported brushing once or twice a day most frequently, with a substantial proportion brushing more than twice daily. In contrast, the majority of patients with severe erosions (BEWE 3) brushed less than once a day or had missing responses.

**Table 5.** How often do you brush your teeth?

		1-2 a day	More than twice a day	Less than once a day	Few times a week	Total
BEWE 0	Count	23	25	4	0	52
	% within BEWE	44.2%	48.1%	7.7%	0.0%	100.0%
2	Count	65	30	9	0	104
	% within BEWE	62.5%	28.8%	8.7%	0.0%	100.0%
3	Count	1	27	44	31	103
	% within BEWE	1.0%	26.2%	42.7%	30.1%	100.0%
Total	Count	89	82	57	31	259
	% within BEWE	34.4%	31.7%	22.0%	12.0%	100.0%

Note. BEWE groups: 0 = patients without erosions, 2 = patients with BEWE 2 stage erosions, 3 = patients with BEWE 3 stage erosions.

Most participants across all BEWE groups reported using harder toothbrushes, with the highest proportion in the BEWE 2 (62.5%) and BEWE 3 (59.2%) groups (Table 6).

Patients without erosions (BEWE 0) were slightly more likely to use harder brushes than softer ones, while a notable portion of BEWE 3 patients (35.4%) were unsure about the type of toothbrush they used. These findings indicate that the choice of toothbrush, particularly the use of harder brushes, may be more common among patients with erosive lesions.

**Table 6.** What kind of teeth brush do you use?

			Softer	Harder	Do not know	Total
BEWE	0	Count	17	28	7	52
		% within BEWE	32.7%	53.8%	13.5%	100.0%
	2	Count	30	65	9	104
		% within BEWE	28.8%	62.5%	8.7%	100.0%
	3	Count	5	61	37	103
		% within BEWE	4.9%	59.2%	35.4%	100.0%
Total		Count	52	154	36	259
		% within BEWE	20.1%	59.5%	13.9%	100.0%

*Note.* BEWE groups: 0 = patients without erosions, 2 = patients with BEWE 2 stage erosions, 3 = patients with BEWE 3 stage erosions.

The question of whether participants grind their teeth during the day revealed significant differences between respondents without erosion and those with diagnosed erosion. While only one person in the category without erosion responded by confirming this habit, almost a third in the BEWE 3 category said that they grind their teeth during the day (Table 7).

This disparity becomes particularly evident when asked about whether they grind their teeth at night (Table 8), as about a third of patients in BEWE2 and BEWE3 have this habit compared to only about 6% in the category of patients without erosion.

**Table 7.** Do you grind your teeth during the day?

			NO	YES	Total
BEWE	0	Count	51	1	52
		% within BEWE	98.1%	1.9%	100.0%
	2	Count	84	20	104
		% within BEWE	80.8%	19.2%	100.0%
	3	Count	75	28	103
		% within BEWE	72.8%	27.2%	100.0%
Total		Count	210	49	259
		% within BEWE	81.1%	18.9%	100.0%

*Note.* BEWE groups: 0 = patients without erosions, 2 = patients with BEWE 2 stage erosions, 3 = patients with BEWE 3 stage erosions.

**Table 8.** Do you grind your teeth during the night?

			NO	YES	Do not know	Total
BEWE 0	Count		37	3	12	52
	% within BEWE		71.2%	5.8%	23.1%	100.0%
2	Count		34	34	36	104
	% within BEWE		32.7%	32.7%	34.6%	100.0%
3	Count		2	60	41	103
	% within BEWE		1.9%	58.3%	39.8%	100.0%
Total	Count		73	97	89	259
	% within BEWE		28.2%	37.5%	34.4%	100.0%

Note. BEWE groups: 0 = patients without erosions, 2 = patients with BEWE 2 stage erosions, 3 = patients with BEWE 3 stage erosions.

Among the examined categories of patients, differences in the experience of stress were also observed. It is highest in the group with the most pronounced erosions and lowest in those without erosions. The statistical analysis shows that all differences are statistically significant at the 0.01 level (Table 9 and 9a).

**Table 9.** Stress among patients with different BEWE categories - Descriptives

BEWE group	N	Mean	Std. Deviation	Std. Error	95% CI for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
0	52	15.57	2.86	.397	14.77	16.37	10	23
2	104	25.92	3.03	.297	25.33	26.51	23	40
3	102	28.55	5.57	.552	27.46	29.65	18	40
Total	258	24.87	6.39	.398	24.09	25.66	10	40

Note. BEWE groups: 0 = patients without erosions, 2 = patients with BEWE 2 stage erosions, 3 = patients with BEWE 3 stage erosions.

\*p < .05 indicates a statistically significant difference between groups.

**Table 9a.** Stress among patients with different BEWE categories - One way ANOVA

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	5994.051	2	2997.026	169.484	.000
Within Groups	4509.224	255	17.683		
Total	10503.275	257			

Note. BEWE groups: 0 = patients without erosions, 2 = patients with BEWE 2 stage erosions, 3 = patients with BEWE 3 stage erosions.

The mean oral health-related quality of life scores increase with the severity of erosive lesions (Table 10 and 10a). Patients without erosions (BEWE 0) reported the lowest mean score (M = 0.80), indicating minimal impact on their oral health-related quality of life.

Those with moderate erosions (BEWE 2) had a substantially higher mean (M = 23.31), while patients with severe erosions (BEWE 3) showed the highest mean score (M = 30.05), suggesting a greater perceived impact. These results highlight a clear trend: as the severity of erosive lesions increases, so does

the reported effect on quality of life. ANOVA analysis shows that all the differences among the subgroups are significant at level 0.01

**Table 10.** Oral health related quality of life among patients with different BEWE categories - Descriptives

	N	Mean	Std. Deviation	Std. Error	95% CI for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
0	52	.80	.950	.131	.54	1.07	.00	3.00
2	104	23.31	3.966	.388	22.54	24.08	16.00	38.00
3	103	30.05	8.217	.809	28.45	31.66	15.00	44.00
Total	259	21.47	12.248	.761	19.98	22.97	.00	44.00

Note. BEWE groups: 0 = patients without erosions, 2 = patients with BEWE 2 stage erosions, 3 = patients with BEWE 3 stage erosions.

**Table 10a.** Oral health related quality of life among patients with different BEWE categories - One way ANOVA

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	30152.377	2	15076.188	451.179	.000
Within Groups	8554.256	256	33.415		
Total	38706.633	258			

Note. BEWE groups: 0 = patients without erosions, 2 = patients with BEWE 2 stage erosions, 3 = patients with BEWE 3 stage erosions.

### Discussion

Tooth wear (TW) refers to the permanent and irreversible loss of hard dental tissues, independent of the presence of bacterial plaque [14]. DA is a process that occurs partly due to physiological factors and is also influenced by age. However, the development of a pathological condition can occur when teeth experience significant wear, leading to changes in both their aesthetic and functional properties [15].

Lussi et al. distinguish two forms of non-carious dental erosion-related dental disease - erosive loss of dental hard tissues and dental erosion [16].

Dental erosion is the chemical loss of dental hard tissues caused by exposure to acids not produced by oral bacteria. Loss of dental hard tissues that occur due to very frequent exposure to acids, such as through increased vomiting, but without mechanical stress, is also attributed to dental erosion. The second form they describe is defined as erosive tooth wear (EAT).

Mechanical forces from, for example, the tongue, cheeks, tooth brushing, tooth grinding, or the use of mechanical force increase the loss of partially demineralized tooth surfaces, leading to cumulative loss of dental hard tissues. Without prior softening, there is virtually no enamel loss due to abrasion with the modern Western diet.

The results presented in this study indicate a consistent and significant association between the severity of erosive tooth wear, as measured by the BEWE, and a wide range of behavioral, psychosocial, and oral health outcomes.

Patients with more severe erosions reported higher consumption of certain acidic foods, especially alcoholic beverages. Although citrus fruit consumption did not differ significantly across BEWE categories, other dietary and behavioral factors showed clear gradients consistent with erosion severity. Dietary intake of acidic foods has been frequently examined in the literature, although there are differences between the

types of acidic beverages consumed. The study by Alghilan et al. focused on examining the erosive potential of fermented dairy products, which they considered to be a major cause of erosion [17].

Rasheed et al. indicated that fruit juices such as orange, blackcurrant, lime, and pineapple have been shown to possess high erosive potential due to their low pH and high titratable acidity [18].

These findings highlight the need for public health strategies that raise awareness on the implications of dietary acids and promote protective oral health behaviours. Dental practitioners should incorporate dietary counselling in routine care, particularly for populations at higher risk. to prevent dental erosion, and to include guidance on their consumption in oral health dietary recommendations.

It is common practice to advise delaying tooth brushing after consuming acidic foods or drinks, which would reduce the effect of erosion. However, there are authors who believe that delayed tooth brushing alone after consuming erosive foods or beverages is not capable of preventing erosive enamel wear [19].

In addition to dietary habits, our patients with a higher degree of erosion also reported less frequent tooth brushing, a higher prevalence of bruxism, higher perceived stress, and a worse quality of life related to oral health. These findings are correlated with studies of Oudkerk and all. [20].

The higher levels of stress and bruxism observed in BEWE 2 and especially BEWE 3 patients support the notion that psychosocial factors may play a contributory or exacerbating role in the progression of erosive lesions. Furthermore, the progressively worse oral health-related quality of life scores with increasing BEWE severity underscore the clinical relevance of erosive tooth wear beyond purely dental findings, reflecting its impact on daily functioning and well-being.

Differences in dental attendance patterns, with severely affected patients reporting longer intervals since their last dental visit, may further contribute to delayed detection and management. Taken together, these results emphasize the need for an integrated preventive approach that combines dietary counseling, oral hygiene education, stress management, and timely dental care, particularly for patients at higher risk of advanced erosive tooth wear.

Several limitations of the present study should be acknowledged. First, the BEWE groups differed in age, which may have influenced both behavioral patterns and clinical outcomes, such as dietary habits, oral hygiene practices, stress levels, and frequency of dental visits.

As a result, some of the observed differences between groups may partly reflect age-related factors rather than the severity of erosive tooth wear alone. Second, the study relied on a convenience sample, which limits the generalizability of the findings to the broader population, as participants may not be fully representative in terms of sociodemographic or health-related characteristics.

Third, although the sample size was sufficient to detect several statistically significant differences, it remains relatively modest, particularly when divided into BEWE subgroups, which may have reduced statistical power for detecting smaller effects and limited more nuanced subgroup analyses. Future research should aim to include more respondents, preferably by balancing the subgroups according to age.

## **Conclusion**

All dietary and behavioral factors showed clear gradients consistent with erosion severity, suggesting that erosive tooth wear is multifactorial and not attributable to a single dietary or behavioral source. Future studies should aim to include more respondents, preferably with age-balanced subgroups.

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