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# The frequency of cervical dentine hypersensitivity and possible etiological factors in an urban population: a cross-sectional study

## Učestalost cervikalne dentinske preosetljivosti i potencijalnih etioloških faktora u gradskoj populaciji: studija preseka

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**Abstract**

**Background/Aim.** Dentine hypersensitivity (DH) is a commonly encountered clinical problem characterized by short, sharp pain which arises from exposed dentine. The aim of this study was to estimate the frequency of cervical DH in adults in Pančevo, Serbia, evaluate the correlation between DH and severity of cervical tooth wear, and investigate the impact of certain etiological factors. **Methods.** The study included 394 subjects, who were clinically examined and interviewed about potential etiological factors using a specially designed questionnaire. The presence of cervical DH was evaluated using cold air stimulation and Schiff ordinal scale. The severity of cervical tooth wear was evaluated using the Basic Erosive Wear Examination (BEWE). Results were analyzed using $\chi^2$ tests and logistic regression at a significance level of $p \leq 0.05$. **Results.** The presence of cervical DH was recorded in 32.9% of the total number of subjects. The $\chi^2$ analysis showed a significant association between clinically elicited and questionnaire-declared DH ($p < 0.001$), but not with the presence of noncarious cervical lesions and the extent of cervical tooth wear. Cervical DH showed a positive correlation with gender ($p < 0.001$), frequent consumption of citrus fruits ($p < 0.001$), and energy drinks ($p = 0.005$). Oral hygiene and other factors were not significantly associated. **Conclusion.** The prevalence of cervical DH in the investigated sample was relatively high. DH was more prevalent among females and significantly associated with frequent consumption of citrus fruits and energy drinks.

**Key words:**
**dentin sensitivity; risk; serbia; surveys and questionnaire; tooth cervix.**

**Apstrakt**

**Uvod/Cilj.** Dentinska preosetljivost (DP) je stanje koje se karakteriše kratkim i oštrim bolom usled izloženosti dentina. Cilj rada bio je da se utvrdi učestalost DP cervikalne regije zuba kod odraslih osoba iz Pančeva, Srbija i da se proceni uticaj stepena trošenja zubne supstance i drugih etioloških faktora na pojavu tog stanja. **Metode.** Studijom su obuhvaćena 394 ispitanika, koji su klinički pregledani i intervjuisani o potencijalnim etiološkim faktorima uz pomoć posebno kreiranog upitnika. Osetljivost cervikalne regije zuba ispitivana je primenom hladnog vazduha i procenjivana Šifovom numeričkom skalom. Procena stepena trošenja cervikalne zubne supstance vršena je primenom indeksa trošenja zuba (*Basic Erosive Wear Examination* – BEWE). Rezultati su analizirani primenom $\chi^2$ testa i logističke regresije na nivou značajnosti $p \leq 0,05$. **Rezultati.** Prisustvo cervikalne DP dijagnostikovano je kod 32,9% ispitanika. Zabeležena je statistički značajna povezanost između klinički dijagnostikovane DP i osetljivosti zuba, prijavljene u anamnezi ($p < 0,001$), ali ne i sa prisustvom nekarijesnih oštećenja cervikalne regije zuba i stepenom trošenja zubne susptance. Pokazana je pozitivna korelacija DP sa polom ($p < 0,001$), učestalom konzumacijom citrusnog voća ($p < 0,001$) i energetskih napitaka ($p = 0,005$), a nije utvrđena korelacija sa ostalim faktorima, kao što je održavanje oralne higijene. **Zaključak.** U ispitanoj populaciji zabeležena je relativno visoka učestalost DP. Značajno viša učestalost zabeležena je među ispitanicima ženskog pola i onima koji često konzumiraju citrusno voće i energetske napitke.

**Ključne reči:**
**dentin, osetljivost; rizik; srbija; ankete i upitnici; zub, vrat.**

### Introduction

The definition of a condition known as dentine hypersensitivity (DH), with minor adjustments, dates from 1983. It is characterized by short, sharp pain arising from exposed dentine in response to thermal, evaporative, tactile, osmotic, or chemical stimuli and cannot be ascribed to any other form of dental pathology. A suggestion from the Canadian Advi

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sory Board on Dentine Hypersensitivity was to change the term pathology into disease. Common terms used to describe this condition are also dentinal, cervical, cemental root sensitivity, or hypersensitivity [1].

Several theories, such as direct innervation theory, odontoblast receptor theory, or hydrodynamic theory, tried to explain the mechanism for DH, although neither leads to a complete understanding of how the various stimuli cause pain. The most widely accepted in the literature is a hydrodynamic theory, stating that the fluids within the exposed dentine tubules are disturbed by chemical or physical changes. Changes and movements of the intratubular fluid stimulate baroreceptors present in the pulp and dentin, which lead to neural discharge and result in painful sensations. For the development of DH, dentin and tubules must become exposed to the oral environment [2].

In most studies, gingival recession, chronic periodontal disease, frequent acidic dietary intake, and oral hygiene factors are considered risk factors for the occurrence of DH. Numerous authors agreed that the etiology is multifactorial and that interactions between several factors play an important role in initiating this condition [3]. A possible association between the presence of noncarious cervical lesions (NCCLs) and cervical DH was also evaluated in some studies. Both conditions are encountered frequently in dental practice and present a challenge for successful treatment. NCCLs and cervical DH occur in the same site of the tooth and, therefore, may be linked. It has been revealed that both conditions are supposed to be produced by a combination of erosion, abrasion, and attrition. However, there is still a lack of data, and differences in clinical characteristics and etiological factors on NCCLs and cervical DH need to be explored further [4].

The aim of this study was to estimate the frequency of cervical DH in an adult population sample in Pančevo, Serbia, to investigate the impact of possible etiological factors on the frequency of DH, and to evaluate the correlation between DH and severity of tooth cervical wear.

## Methods

A cross-sectional study was conducted on a sample of patients selected by convenience sampling method, who approached the Department of Restorative Dentistry and Endodontics, Faculty of Dentistry in Pančevo, Serbia, for routine dental examination and possible treatment. The study involved adult patients aged over 18 years of both genders. The inclusion criteria for the participants were the following: a) to have a minimum of eight eligible teeth, b) absence of systematic diseases, and c) to be able to read and understand the questionnaire used in this study. Exclusion criteria were the following: dental bleaching procedures performed in the last 6 months, presence of large quantities of calculus on teeth, ongoing orthodontic treatment, and medication with sedatives, drugs, or desensitization agents that could affect the threshold of pain. The sample size was determined using the statistical power analysis program "G*Power 3.1" [5]. The calculation was based on the pilot study with a preliminary sample of 30 subjects, selected by convenience sampling method, as proposed by Browne [6], who approached routine dental examination and possible treatment. The calculation was done according to the sample analysis, and the proportion of the respondents with and without clinically elicited DH was 30% vs. 70% and 1.4 or higher odds ratio values for most of the tested variables. Alpha was set to 5%, and the power of 0.80 was considered acceptable. According to these parameters, a sample size of at least 344 participants would be required. The final study sample included 394 subjects (169 male and 225 female) divided into three age groups. The study was conducted in complete accordance with the World Medical Association's Declaration of Helsinki. Prior to the investigation, participants were fully informed about the study and gave written consent to participate as a volunteer. Investigations in this study were approved by the Ethics Commission of the Faculty of Dentistry in Pančevo (Approval Protocol No. 882/1–2014, according to Resolution sections 3, 7, and 8 of the National Commission of Ethics in Research).

Each participant completed a specially designed questionnaire created by researchers of this study and similar to those employed in previous studies, identifying etiological factors for DH and NCCLs [4, 7]. It included basic personal information and questions related to potential etiological factors, such as daily erosive dietary intake, carbonated and energy drinks consumption, bruxism and other bad habits, smoking, lifestyle, oral hygiene habits (daily tooth brushing frequency, bristle type, brushing movements, etc.). A test-retest correlation on a preliminary sample of subjects at two distinct periods was used to test the reliability of the questionnaire. The correlation coefficient (r) was 0.86, which was considered good.

Each patient was subjected to clinical examination for cervical DH and tooth wear. The presence of cervical DH was tested on all eligible teeth, excluding third molars, endodontically treated teeth, crowned teeth, and teeth with cervical caries and restorations. The cervical region of the tooth was subjected to cold air stimulation for 2 sec from a triple air dental syringe and a distance of approximately 1 cm. Adjacent teeth were shielded by the fingers of the other hand. The subject's response to the stimulus was evaluated using the Schiff ordinal scale (0 = subject does not respond to sensitivity, 1 = subject responds to stimulus but does not request discontinuation, 2 = subject responds to stimulus and requests discontinuation or moves from the stimulus, 3 = subject responds to stimulus, considers stimulus to be painful and requests discontinuation) [8]. The procedure was repeated for each eligible tooth. NCCLs were evaluated using the Basic Erosive Wear Examination (BEWE). Buccal/facial and lingual/palatal surfaces on all eligible teeth were examined, and the scores were given as follows: 0 = no surface loss, 1 = initial loss of enamel surface texture, 2 = distinct defect, surface loss < 50%, and 3 = surface loss > 50%. Only the highest score for each teeth sextant was recorded. After all the

sextants had been assessed, the cumulative score of all sextants was calculated [9].

The investigation was conducted by a single examiner, previously instructed regarding DH evaluation using the Schiff ordinal scale and NCCLs evaluation using the BEWE index. An intra-examiner agreement was calculated after examination of the preliminary sample, two times with an interval of two weeks, following recommendations from the World Health Organization (WHO) for reliability and validity of data. Cohen's Kappa value index was 0.92, which is considered excellent.

The collected data were analyzed using the statistical software SPSS v20.0 (IBM Inc, USA). Descriptive statistics for Schiff values were expressed as numbers and percentages for the respective groups (gender, age). Subject-level analysis was used to evaluate the association between possible etiological factors and clinically elicited DH. For that purpose, all subjects were divided into two groups regarding the presence of DH (maximum Schiff value 1-3) or absence (maximum Schiff value 0). The relationship between the presence of NCCLs, the severity of cervical tooth wear, questionnaire-declared hypersensitivity, and clinically elicited DH was estimated using the $\chi^2$ test. The association of other possible etiological factors from the questionnaire with the clinically elicited DH was analyzed using logistic regression. Each factor was first employed as an independent variable in a univariate unconditional logistic regression, with the presence of DH as a dependent variable. Factors that showed significant correlation were then used as independent variables in the multivariate logistic analysis. The strength of association was presented by odds ratio (OR) at a significance level of $p \leq 0.05$ with a 95% confidence interval (CI). The logistic regression model was reviewed for goodness-of-fit and validated using the Hosmer-Lemeshow statistics.

## Results

The study included 394 patients – 169 males and 225 females. The youngest one was 19, the oldest one was 81, and the average age of the study sample was 45.4. The presence of cervical DH (maximum Schiff value ≥ 1) was diagnosed in 32.9% of subjects, while the frequency of NCCLs was 68.5%. The presence of both cervical DH and NCCLs was diagnosed in 22.8% of the total number of subjects. Among 69.2% of subjects with cervical DH, the presence of NCCLs was also registered (Table 1).

**Table 1**

**Frequency of subjects with cervical dentine hypersensitivity (DH) and noncarious cervical lesions (NCCLs)**

| Parameter | DH (maximum Schiff value ≥ 1) | | Total n (%) |
|---|---|---|---|
| | yes n (%) | no n (%) | |
| NCCLs | | | |
| yes | 90 (22.8) | 180 (45.7) | 270 (68.5) |
| no | 40 (10.2) | 84 (21.3) | 124 (31.5) |
| Total | 130 (32.9) | 264 (67.1) | 394 (100) |

DH was more frequently (43.6%) diagnosed among females than among males (18.9%). In contrast, a higher percentage of subjects with at least one NCCL was recorded among males (76.3%) than among females (62.7%) (Figure 1). The frequency of subjects with cervical DH was almost equally distributed among age groups, with the highest frequency in the group of 36–54 years (38.8%). The percentage of subjects with NCCLs increased with age, with a frequency of 94.7% in the group over 55 years of age (Figure 2).

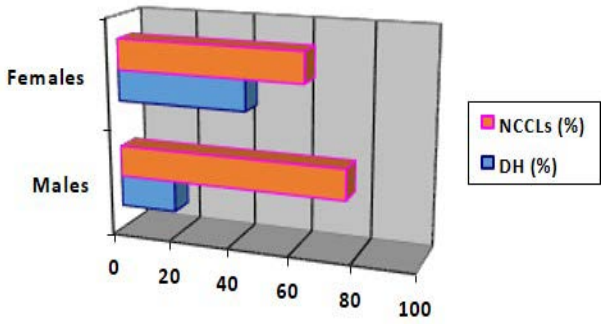


**Fig. 1 – Distribution of subjects with cervical dentine hypersensitivity (DH) and noncarious cervical lesions (NCCLs) concerning gender.**

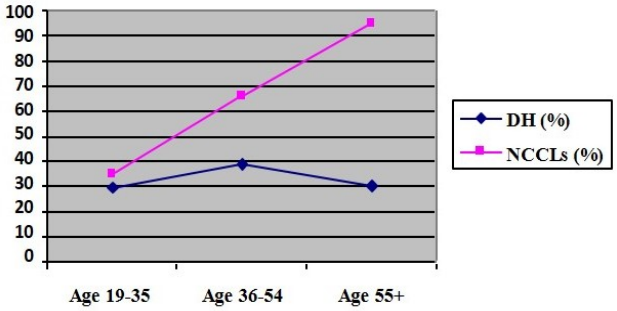


**Fig. 2 – Distribution of subjects with cervical dentine hypersensitivity (DH) and noncarious cervical lesions (NCCLs) concerning age.**

The majority of male subjects (81.1%) and more than half of females (56.4%) did not respond to cold air stimulation (Schiff value = 0). Between those who responded in some manner, the less intensive response to a stimulus (Schiff value = 1) was the most frequent among both genders and all three age groups. The most intensive response (Schiff value = 3) was recorded only among females (3.6%) and subjects over 55 years of age (5.3%) (Table 2).

**Table 2**

**Response to cold air stimulation concerning gender and age**

| Parameter | Maximum Schiff value, n (%) | | | |
|---|---|---|---|---|
| | 0 | 1 | 2 | 3 |
| Gender | | | | |
| male | 137 (81.1) | 24 (14.2) | 8 (4.7) | 0 (0) |
| female | 127 (56.4) | 64 (28.4) | 26 (11.6) | 8 (3.6) |
| Age (years) | | | | |
| 19–35 | 74 (70.5) | 21 (20.0) | 10 (9.5) | 0 (0) |
| 36–54 | 85 (61.2) | 42 (30.2) | 12 (8.6) | 0 (0) |
| 55+ | 105 (70.0) | 25 (16.7) | 12 (8.0) | 8 (5.3) |
| Total | 264 (67.1) | 88 (22.3) | 34 (8.6) | 8 (2.0) |

**Table 3**

**Association between clinically elicited cervical dentine hypersensitivity (DH) and presence of noncarious cervical lesions (NCCLs), cervical tooth wear, and questionnaire-declared hypersensitivity**

| Paramater | Total number | Cervical DH n (%) | Odds ratio | 95% CI | $\chi^2$ | *p* |
|---|---|---|---|---|---|---|
| Presence of NCCLs | | | | | | |
| no | 124 | 40 (32.3) | 1 | | | |
| yes | 270 | 90 (33.3) | 1.05 | 0.67–1.65 | 0.044 | 0.833 |
| Maximum BEWE score | | | | | | |
| 0 | 124 | 41 (33.1) | 1 | | | |
| 1 | 132 | 36 (27.3) | 0.759 | 0.44–1.29 | 3.194 | 0.313 |
| 2 | 89 | 33 (37.1) | 1.193 | 0.67–2.11 | 0.760 | 0.544 |
| 3 | 49 | 21 (42.9) | 1.518 | 0.77–2.99 | 2.328 | 0.228 |
| Declared DH | | | | | | |
| no | 297 | 55 (18.5) | 1 | | | |
| yes | 97 | 76 (78.3) | 15.924 | 9.05–28.02 | 117.941 | < 0.001 |

**CI – confidence interval; BEWE – Basic Erosive Wear Examination.**

**Table 4**

**Results of univariate and multivariate logistic regression for the presence of cervical dentine hypersensitivity (DH)**

| Factors | Elicited DH | Univariate logistic regression analysis | | | Multivariate logistic analysis | | |
|---|---|---|---|---|---|---|---|
| | n (%) | OR | 95% CI | *p* | OR | 95% CI | *p* |
| Gender | | | | | | | |
| male | 33 (19.5) | 1 | | | 1 | | |
| female | 98 (43.5) | 3.180 | 2.00–5.05 | < 0.001 | 2.774 | 1.71–4.49 | < 0.001 |
| Age (years) | | | | | | | |
| 19–35 | 31 (29.5) | 0.977 | 0.57–1.69 | 0.935 | | | |
| 36–54 | 54 (38.8) | 1.528 | 0.94–2.49 | 0.088 | | | |
| 55+ | 45 (30.0) | 1 | | | | | |
| Citrus fruits | | | | | | | |
| no/rarely | 22 (16.7) | 1 | | | 1 | | |
| often | 109 (41.6) | 3.562 | 2.12–5.99 | < 0.001 | 3.285 | 1.87–5.76 | < 0.001 |
| Fruit juices | | | | | | | |
| no/rarely | 72 (35.6) | 1 | | | | | |
| often | 59 (30.7) | 0.801 | 0.53–1.22 | 0.301 | | | |
| Carbonated drinks | | | | | | | |
| no/rarely | 96 (35.0) | 1 | | | | | |
| often | 35 (29.2) | 0.763 | 0.48–1.22 | 0.256 | | | |
| Energy drinks | | | | | | | |
| no/rarely | 116 (31.8) | 1 | | | 1 | | |
| often | 15 (51.7) | 2.300 | 1.07–4.92 | 0.032 | 3.657 | 1.47–9.11 | 0.005 |
| Milk | | | | | | | |
| no/rarely | 22 (39.3) | 1 | | | | | |
| often | 109 (32.2) | 0.736 | 0.41–1.32 | 0.302 | | | |
| Chewing gums | | | | | | | |
| no/rarely | 54 (36.2) | 1 | | | | | |
| often | 77 (31.4) | 0.806 | 0.53–1.24 | 0.326 | | | |
| Smoking | | | | | | | |
| no | 86 (38.2) | 1 | | | 1 | | |
| yes | 45 (26.6) | 0.587 | 0.38–0.90 | 0.016 | 0.715 | 0.44–1.15 | 0.168 |
| Parafunctions | | | | | | | |
| no | 96 (33.6) | 1 | | | | | |
| yes | 35 (32.4) | 0.949 | 0.59–1.52 | 0.828 | | | |
| Brushing frequency | | | | | | | |
| 1 per day | 26 (26.0) | 0.586 | 0.25–1.36 | 0.214 | | | |
| 2 per day | 52 (37.7) | 1.008 | 0.45–2.23 | 0.985 | | | |
| ≥ 3 per day | 12 (37.5) | 1 | | | | | |
| Toothbrush | | | | | | | |
| soft | 20 (31.2) | 0.559 | 0.23–1.38 | 0.207 | | | |
| medium | 47 (36.4) | 0.705 | 0.31–1.59 | 0.401 | | | |
| hard | 13 (44.8) | 1 | | | | | |
| Movements | | | | | | | |
| vertical | 31 (36.9) | 1 | | | | | |
| horizontal | 22 (37.9) | 1.045 | 0.52–2.08 | 0.901 | | | |
| circular | 20 (37.0) | 1.006 | 0.49–2.04 | 0.987 | | | |
| variable | 58 (29.3) | 0.708 | 0.41–1.21 | 0.209 | | | |
| Brushing after meal | | | | | | | |
| no | 92 (30.1) | 1 | | | 1 | | |
| yes | 39 (44.3) | 1.851 | 1.14–3.01 | 0.013 | 1.454 | 0.85–2.48 | 0.167 |

**OR – odds ratio; CI – confidence interval.**

The $\chi^2$ analysis showed a significant association between clinically elicited sensitivity (maximum Schiff value ≥ 1) and questionnaire-declared hypersensitivity ($p < 0.001$). A significant association between the presence of cervical DH and the presence of NCCLs was not recorded ($p = 0.833$). The presence of cervical DH showed a growing tendency with the severity of cervical tooth wear, but the association was not statistically significant (Table 3).

The results of univariate unconditional logistic regression showed a direct link between the presence of cervical DH and gender ($p < 0.001$), frequent consumption of citrus fruits ($p < 0.001$) and energy drinks ($p = 0.032$), smoking cigarettes ($p = 0.016$), and brushing teeth immediately after a meal ($p = 0.013$). After conducting the multivariate logistic regression analysis, only gender ($p < 0.001$) and frequent consumption of citrus fruits ($p < 0.001$) and energy drinks ($p = 0.005$) were associated with the presence of cervical DH (Table 4).

## Discussion

There is a growing awareness in the literature that DH represents an important issue that affects the quality of life of many individuals worldwide. Equally important is to study this condition both from a diagnostic and therapeutic perspective. The majority of researchers used cold air stimulation from a triple-air dental syringe or scratching the tooth with a dental probe to provoke DH-associated pain. The patient's response to the presenting stimulus has been the primary way for evaluation because of the ability to quantify the condition using a pain rating scale [10–12].

There is a wide range of data in the literature regarding the prevalence of DH. Rahiotis et al. [13] tried to explain that by a certain factor related to the design issues of each study, such as different types of stimuli applied to provoke the sensitivity, the methodology for assessing DH, the number and the profile of the participants, and different settings (general practice or university/hospital clinic). Recent review paper reported a prevalence range from 1.3% to 92.1%. Summary estimation was 11.5% and 33.5% for the fixed and random-effects meta-analysis models, respectively [14]. The results of the present study revealed a prevalence of 32.9%, which corresponds to that estimation.

A high discrepancy in the literature is also present regarding the prevalence of NCCLs, with a range between 9.1% and 93%. In the systematic review, Teixeira et al. [15] estimated a mean prevalence of 40.7%, with a higher prevalence (54%) in studies with older populations. The prevalence of NCCLs in the present study (68.5%) was higher than average but similar to the results of two studies from close geographical regions, which revealed a prevalence of 65% and 52% [16, 17].

Despite the assumption of similar etiology, epidemiological studies that correlate the presence of NCCLs and cervical DH are not very common due to the difficulty in comparing data from different populations. Several studies revealed a significant association between the presence of cervical DH and NCCLs [4, 13, 18, 19]. Cunha-Cruz et al. [20] have not found a significant association between the two conditions, which was also the case in the present study. The reason could be the fact that NCCLs were not considered separately by type (erosion, abrasion, abfraction) but cumulatively. The association between the severity of tooth wear and cervical DH is still scarce in the literature. Some studies found a positive correlation [21–23]. Reasons could be the proximity of the lesion with the pulp, the amount of exposed dentinal tubules, and the theory that root exposition makes the tissue more vulnerable to the influence of risk factors [24]. In the present study, despite a positive correlation between the presence of cervical DH and the severity of cervical tooth wear, the association was not statistically significant. A possible explanation could be the fact that not all exposed dentine is sensitive. There must be an opening of the dentinal tubule system to permit activation of the hydrodynamic mechanism by appropriate stimuli [23]. NCCLs development tends to be a slow, chronic process that occurs over an extended period. Therefore, sclerosis, lack of secondary dentin deposition, occlusion of open dentinal tubules, pulpal retreat, and other natural tooth-protective measures slowly adapt to the noxious stimuli and minimize sensitivity [25].

Clinically elicited cervical DH and questionnaire-declared hypersensitivity were significantly associated in the present study. Self-reported prevalence (24.6%) was lower compared to clinically elicited DH (32.9%). A similar result was obtained in the West et al. [22] and Barroso et al. [26] studies, which tried to explain the fact that the severity of pain is proportional to the stimulus strength, the subject's psychological state, and anxiety of the expected pain. Moreover, most of the clinically tested subjects showed less intensive response to a stimulus (maximum Schiff value = 1), suggesting no interference of pain in daily life. In contrast, Savage et al. [23] reported a higher prevalence of questionnaire-declared DH compared to clinically diagnosed.

The results of the present study indicated a significantly higher prevalence of cervical DH among females. However, the reasons are not yet clear, but it could be because females have better overall healthcare and oral hygiene awareness. That could make them become more sensitive, evoke different responses to stimuli or lower pain threshold, anticipate pain differently, and show a tendency to eat acidic food more frequently [4, 13, 24, 27]. It should be mentioned that there are studies in which significant difference between genders was not recorded [2, 22, 23]. It is fair to say that the correlation between age and the prevalence of cervical DH is still unclear. Although the reported peak in the literature is between 20 and 50 years, many researchers concluded that there is a tendency for this to decline with age, mainly because of the age-related changes in the dentin-pulp complex. In addition, the fact that the extent of periodontal diseases and gingival recession that cause cervical DH increases with age must be considered; that could lead to higher prevalence among older patients [2, 13]. The highest frequency of cervical DH in the present study was recorded among middle-aged subjects (36–54 years) but without significant association.

The influence of acidic dietary intake on the occurrence of NCCLs and cervical DH is often evaluated in epidemio-

logical studies. The cervical tooth region is prone to erosion because of the proximity to the gingival margin and weak ability to self-cleaning. Therefore, the erosive potential of acidic dietary products lasts for a longer period. High concentrations of processed carbohydrates, stimulation of higher levels of acid production, and higher titratable acidity are the reasons why soft drinks, fruit juices, and energy drinks have erosive potential. As a result of dentine erosion, the smear layer disappears, and dentinal tubules become opened [1]. In the present study, frequent consumption of citrus fruits and energy drinks was significantly associated with the presence of cervical DH. Similar results were obtained by West et al. [22], Savage et al. [23], and López et al. [28]. Yoshizaki et al.[18] found a significant correlation between frequent consumption of acidic fruit juices and DH diagnosed with air blast, while there are a certain number of studies in which significant association with acidic dietary intake was not recorded [13, 15, 29].

Cervical DH can occur among patients with good oral hygiene and limited bleeding on probing. Gingival recession can result from aggressive and inappropriate tooth brushing, which exposes dentine to further abrasive wear and increases the risk of developing DH. Many researchers tried to establish the connection between tooth brushing habits and the prevalence of DH, but it seems that a clear association could not be established, probably due to the condition's multifactorial nature. Scaramucci et al. [30] found that subjects who brush their teeth four times a day and those who apply excessive force during brushing could be more prone to DH but could not find a correlation with the hardness of different brush bristles. Among all evaluated oral hygiene factors, Que et al. [4] found only frequent tooth brushing as a risk factor for DH. In the present study, besides a slightly higher prevalence of cervical DH among subjects who use hard toothbrushes, horizontal movements, and brush their teeth immediately after a meal, a significant association was not recorded. Similar results were obtained in a number of other studies [13, 20, 22, 24, 29].

The effect of smoking on the development of periodontal destruction is well established. However, the data from the present study found no such association, which was also the case in studies by Rahiotis et al. [13] and Mahdisiar et al. [31]. In some studies, parafunctional habits, such as bruxism, were also reported as contributing factors to the occurrence of cervical DH. A possible explanation could be that during parafunctional loading, cyclic tension and compression stresses occur in the cervical tooth region, which leads to the loss of tooth structure at the cemento-enamel junction and consequently the occurrence of hypersensitivity [32]. Furthermore, the assumption is that bruxers exhibit an altered perception of painful stimuli as a result of increased levels of anxiety and depression [2, 30 33]. No significant association between cervical DH and parafunctional habits was recorded in the present study. Teixeira et al. [24] also found no significant association.

Some limitations of the present study should be considered. Many investigators have suggested using at least two methods in the diagnosis of cervical DH, such as tactile and air-blast stimulation, due to the strong placebo effect and subjectivity of pain response. In the present study, tactile stimulation was not used since it is difficult to standardize the applied pressure, which could lead to the fact that, even with a negative response to a tactile stimulus in the clinical environment, patients may still have DH-pain caused by mechanical stimuli in their everyday life [11]. Although the study sample consisted of subjects from the region, it could not be considered nationally representative. However, the results from cross-sectional studies are useful for estimating the frequency of cervical DH and identifying etiological factors in certain regions, which could be used as a starting point for further longitudinal evaluations involving a larger sample, nationally representative.

## Conclusion

Within the limitations of this study, it can be concluded that the prevalence of cervical DH in the investigated sample was relatively high. The factors associated with the presence of cervical DH were female gender and frequent consumption of citrus fruits and energy drinks. Clinically elicited cervical DH was significantly associated with the questionnaire-declared hypersensitivity but not with the presence of NCCLs and the severity of cervical tooth wear. Obtained results support findings on the multifactorial nature of cervical DH.

## Conflict of interest

The authors declare no conflict of interest.

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